

REPORT  
OF THE  
NEW JERSEY STATE  
MUSEUM  
1905.

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See Annual Report













EDWARD C. STOKES,  
GOVERNOR OF NEW JERSEY.

*Frederick L. Hagan*

# ANNUAL REPORT

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OF THE

## New Jersey State Museum

Including a list of the Specimens received  
during the year

### FINANCIAL REPORT

With a Report of the

## Fresh and Salt Water Fish found in the Waters of New Jersey

FULLY ILLUSTRATED

1905



TRENTON, N. J.  
MACCRELLISH & QUIGLEY, STATE PRINTERS.

1906





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## PART I.

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## Commissioners of the New Jersey State Museum.

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STATE SUPT. OF PUBLIC INSTRUCTION, CHARLES J. BAXTER, *President*.

STATE GEOLOGIST, HENRY B. KÜMMEL, *Secretary*.

PRESIDENT STATE BOARD OF AGRICULTURE, E. B. VOORHEES.

PRESIDENT OF THE SENATE, WILLIAM J. BRADLEY.

SPEAKER OF THE HOUSE OF ASSEMBLY, JOHN BOYD AVIS.

SILAS R. MORSE, *Curator*.

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## Heads of the Several Departments of the New Jersey State Museum.

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C. J. BAXTER, STATE SUPERINTENDENT OF PUBLIC INSTRUCTION,  
*Educational*.

E. B. VOORHEES, RUTGERS COLLEGE,  
*Agriculture*.

HENRY B. KÜMMEL, STATE GEOLOGIST,  
*Geology*.

JOHN C. SMOCK, EX-STATE GEOLOGIST,  
*Forestry*.

AUSTIN C. APGAR, STATE NORMAL SCHOOL,  
*Birds and Botany*.

JOHN B. SMITH, STATE ENTOMOLOGIST,  
*Entomology*.

JAMES T. MORGAN, DEPUTY OF BUREAU OF LABOR STATISTICS,  
*Manufactures*.

WILLIAM H. WERNER, *Taxidermist of Museum*.

HERBERT M. LLOYD, *Archaeology*.



## Letter of Transmittal.

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TRENTON, N. J., November 30th, 1905.

*To the Honorable Edward C. Stokes, Governor of the State of  
New Jersey:*

SIR—I have the honor to present, for the Commissioners, the Annual Report of the New Jersey State Museum, including a report of the Fish of New Jersey.

SILAS R. MORSE,

*Curator.*



## The Curator's Report.

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In presenting the report of the New Jersey State Museum for 1905 we have decided to devote the major part of it to "The Fish of New Jersey." We do not find any reference work on this subject which is just what is needed for the Museum, or the general public. There have been several reports containing lists of the fish of New Jersey published by the Geological Survey of the State, notably one by Dr. C. C. Abbott, in Cook's Geology of New Jersey, 1868, and the other by Dr. Julian Nelson, in Vol. 11 of the Final Report, 1890, but neither of these was illustrated. The later work has given more detailed information regarding the occurrence of species in New Jersey waters.

The Commission feel that it has been fortunate in procuring the services of Mr. Henry W. Fowler, of the Philadelphia Academy of Natural Sciences, to prepare this part of the report.

Mr. Fowler has been studying the fish of New Jersey for the past five years, and has added much important information to this subject during those years. We feel that this report will be not only a credit to the Commission of the New Jersey State Museum, but also to the State and to Mr. Fowler. It will contain about 200 illustrations.

Since our last Report, the Exhibits from St. Louis have been returned to us, and nearly all have been set up in the Museum in the State House, thus filling every available space.

The Educational Exhibit was placed in the rooms and corridors formerly containing the Educational Exhibit from Chicago, Buffalo and Charleston Expositions. The former Exhibits, with what we have of the Educational Exhibits from the Philadelphia Centennial and the New Orleans Expositions, have been condensed and filed in the Museum for comparison.

The other St. Louis Exhibits have been placed in the new Exposition Hall.



The Geological Exhibits have been newly numbered, listed and a card system made for them. We have one new set of cabinets for the display and storage of the geological specimens, and have ordered two more. When these are in place the old cases will be removed. This will give us some additional space to use many specimens we have not heretofore been able to display. These are stored in the basement of the State House or loaned to other institutions.

The other Exhibits—Birds, Fish, Insects, Quadrupeds, etc.—are all in place and are being listed and labeled.

We are preparing a card system of all of the specimens in the Museum. When this is done we shall be able to locate and have described every specimen in the Museum with very little trouble.

#### MORE ROOM.

Again we have to urge more and better rooms for displaying the specimens now in the possession of the Commission and for those we are continually receiving.

The Commission, at one of its recent meetings, recommended that the State House Commission be asked to urge the construction of a new building or more rooms for the State Museum. Messrs. Kümmel and Morse were appointed a committee to make plans for a new building and submit them to the State House Commission for their inspection and approval. The future success of the Museum depends upon having more room to accommodate its rapid growth.

The State House Commission have done much to assist the Commission to improve the Museum. The Legislature gave the Commission the appropriation asked, thus enabling it to go on with the work as proposed.

The assigning of a man to have full charge of the rooms and see that everything is kept clean has proved a success, thus showing their wisdom.

## THE NEW SHOW CABINETS.

During the year the question of new cases for the geological specimens, which shall at the same time give adequate space for the display of choice specimens, ample storage room for duplicate material and be artistic in outline and general effect, has received much study. The model finally adopted consists of three parts—a vertical case with glass sides and ends, 2 feet high, 1 foot wide and  $4\frac{1}{2}$  feet long, with a plate-glass shelf; two desk cases, back to back and supporting the vertical case, and measuring  $4\frac{1}{2}$  feet by  $2\frac{1}{2}$  feet, furnish additional display space. Below each desk case are three compartments, with shelves and drawers, each compartment having space for twelve drawers. Three such units giving 74 sq. ft. of display space, 648 sq. ft. of storage space and occupying 63 sq. ft. of floor space, have been made and six more have been ordered.

## NEW JERSEY HAS BEEN NOTED FOR ITS FISH.

The vocation of fishing has been followed for generations, as far back as the history of the State has any record; in fact, it was a happy hunting and fishing grounds for the Indians long before it was known to the white man.

It would seem, if the following be true, and Mr. Wootton personally informed the writer that it was true, that New Jersey was inhabited many thousand years ago. Several years ago Mr. Wootton's men, when digging clay from the pit near Egg Harbor City, in Atlantic county, N. J., found at the bottom of the pit, some ten or twelve feet under the surface, on the sand, an earthen pot or kettle, and by its side what seemed to be burned pieces of wood. This same kettle is now in the possession of Mr. Wootton.

Along the coast huge piles of oyster and clam shells are found where the red men held their feasts, and in these mounds numerous fish bones, arrow heads and other relics are found.

## 12 REPORT OF NEW JERSEY STATE MUSEUM.

Large quantities of fish have been caught along the coast, in bays, rivers and ponds annually and sent to market. We do not in this statement refer to the shell fisheries of the State, for which New Jersey is noted all over the whole world.

We have been unable to find any approximate value of the fish, other than shad, that are annually caught for the market or home consumption.

### WHAT THE NEW JERSEY BOARD OF FISH AND GAME COMMISSIONERS OF THE STATE OF NEW JERSEY ARE DOING TO STOCK THE STREAMS AND OTHER WATERS WITH FISH.

For the past two years, under the Hon. Benj. P. Morris as President, this Commission has been doing good work in this branch of their duty. The Commissioners of the State Museum and the Curator feel gratified for the assistance received from the Fish and Game Commissioners and to know the two Commissions are working in harmony. In our last report we gave credit for the specimens received from the Commissioners, to show what it did to assist the State Museum Commission in its Fish and Game Exhibit at St. Louis. We quote the following from the report of the Fish and Game Commission of 1904:

"It is with no little pride that your Commission refers to the exhibit of the State of New Jersey at the St. Louis Exposition. Your Commission worked in harmony and assisted in every way possible the New Jersey Commissioners to the Exposition in preparing the exhibit.

"In addition to the fish and game exhibits already mounted and prepared, which the State had on hand in the Museum at Trenton, your Commission procured through the wardens the following fish and game for mounting purposes, to wit:

"Two large-mouthed black bass, male and female; 2 cat fish, male and female; 2 yellow perch, male and female; 2 Delaware river shad, male and female; 2 carp, male and female; 2 sea bass, male and female; 2 porgies, male and female; 1 polluck; 1 king fish; 2 butter fish; 1 fluke; 1 weak fish; 1 eel; 1 herring;

1 black fish; 1 frost fish; 2 salmon; 1 striped bass or rock fish; 1 blue fish; 1 wall-eyed pike; 2 Boston mackerel; 2 Belgian hares.

"With but one exception every one of the foregoing list of fish were taken from the waters of New Jersey, and every one of the varieties above mentioned are, to a more or less extent, found in the State at some season of the year. These fish were mounted in elegant shape, and sent to the Exposition.

"In addition to those specimens mounted dead, there were taken from along the coast various samples of salt water fish, which were conveyed to St. Louis in cars, and there placed in tanks previously supplied with salt from the coast by the Exposition authorities.

"The New Jersey Exhibit has been the wonder of the visitors, and, as a result of its uniqueness and perfection, received the highest reward given by the Exposition. This certainly should be a source of gratification to all of the residents of this State, and a satisfactory recognition of the efforts being put forth by your Commission in the interests of the State.

"We further beg to report that during the past season your Commission has procured various samples of small fresh and salt water fishes, which they have forwarded to Prof. John B. Smith, of New Brunswick, N. J., for scientific investigation, and for the purpose of ascertaining whether or not fishes of such character are destroyers of mosquito larva."

The Fish and Game Commission truly say that although our State is comparatively small in area, it has great length in river and sea front and its geographical position makes it well adapted for the production of extensive commercial fisheries. Although many species of fish are caught and marketed, the shad fishery is the most important. The catch of shad in New Jersey is greater than any other State in the Union, or about one-fourth of the entire country. The most of these—90%—are taken from the Delaware river.

The earlier shad fisheries were established in the upper Delaware on the Pennsylvania shore in 1750, on the New Jersey side in 1820. Now shad fishing is conducted on a large or small scale from Bayside to the Delaware Water Gap.

The number of men employed in catching shad is over 2,000; the number of boats, nearly 1,000; the number of nets, 830; value of apparatus, including boats, nets, etc., \$11,300. Total value of the catch in 1903, \$325,000. The United States Fish Commission is doing everything possible to keep the Delaware river stocked. The steamer "Fish Hawk" has been stationed near Gloucester, N. J., every year, where millions of eggs are hatched and the fry deposited in the upper Delaware.

#### BAIT FISH.

Another important thing is the protecting and increasing of bait fish, in order to supply food for preserving and maintaining the supply of food-fish in our waters. Without food the fish placed in the water would not live and increase.

Fish introduced by the Fish and Game Commissioners during the past year, 1905:

They have introduced wall-eyed pike, channel catfish, calico bass and crappies.

The wall-eyed pike were first brought from Lake Erie several years ago, and have multiplied and now appear in large numbers in the lakes in the northern part of the State where they were placed.

Large numbers of calico bass and crappies have been caught. 23,865 black bass, perch, pickerel, crappies, catfish and butterfish were distributed. Over 25,000 brook, or square-tailed trout, were distributed during the past year in suitable streams in the northern part of the State.

The same Commission will place 40,000 trout in the streams during this fall and winter, besides large supplies of other fresh-water fish. The Commission report that, unfortunately, shad are disappearing from the Delaware river. The Commission has done all it could to overcome this condition. It has, in connection with the Pennsylvania and United States Commission, placed 3,806,000 shad fry in the Delaware river. They attribute it to the closed time being too short.



In the report of the Fish and Game Commission of 1904 it seemed to convey the opinion that the bringing of wall-eyed pike, channel catfish, calico bass and crappies from Lake Erie was not successful, but we are glad to see by the report of 1905 (advanced sheets of which have been loaned us) that during the past year this opinion has not proved true. We give what it says on this subject:

"The result was watched very carefully. In 1903 we had almost come to the conclusion that the experiment was a failure, for while some of the introduced species were caught, they did not appear in numbers sufficient to warrant a continuance of the work.

"Your Commission is gratified to report that their hopes have been realized.

"During the past summer the wall-eyed pike have made their appearance in Greenwood Lake and Lake Hopatcong in large numbers. They are hailed with delight by all persons visiting those waters, and large catches of these fish are made almost every day, the size being from two to four pounds weight. Specimens have been taken, however, weighing six and one-half pounds.

"The calico bass and crappies have also multiplied greatly. Evidence of this has been obtained both from the number of fish caught by rod and reel and the fact that when bait nets are used thousands of small calico bass and crappies are caught at every haul. This shows that these two large bodies of water are well adapted for almost every species of fish."

The Fish and Game Commission this year (1905) report that the State has no fish hatcheries and must purchase its supply of game fish from other States, or depend upon the Delaware and Raritan canal to stock the lakes and streams of the State. It being a cold winter, the supply from the canal was much smaller than formerly. Pickerel, perch and catfish were taken from ponds and streams that were likely to dry up in the summer.

Several thousand catfish and bait fish were taken from old cranberry bogs in the southern part of the State. In this it has procured 23,865 fish—475 black bass, 2,675 perch, 2,490 pickerel, 25 crappies, 11,000 catfish and 6,600 bait fish. They were

## 16 REPORT OF NEW JERSEY STATE MUSEUM.

placed in the larger waters of the State. There were purchased 25,750 brook trout to be placed in suitable streams of the State. These trout were four or five inches in length and in good condition. This is not only of greater value to the citizens of the State in supplying them with food and sport, but a greater revenue to the State in bringing sporting men to the State, who spend many thousand dollars annually. Thus the farmer, hotel proprietor, railroad, etc., are mutually benefited, many fold more than the amount expended by the Commission.

During the past year (1905) a new agreement for hatching shad was entered into between the United States Fish Commission, the Department of Fisheries of Pennsylvania and the New Jersey Fish and Game Commission, to hatch eggs at the Torresdale, Pa., hatchery.

The United States Fish Commission supplied the men to take the eggs and attend to the work of hatching, the Department of Fisheries of Pennsylvania furnished the plant and the New Jersey Fish and Game Commission furnished the launch "Protector," with crew, to transport the eggs after they were collected from the fisheries.

Pennsylvania delivered the fry in cans at Trenton, and New Jersey distributed them in the head waters of the Delaware. The supply thus obtained was not as large as usual, but 3,256,000 fry were distributed.

After the United States Fish Commission discontinued its work, June 1st, Pennsylvania and New Jersey continued and distributed 550,000 additional, making a total of 3,806,000 shad fry hatched and placed in the Delaware river.

### SALT-WATER FISH.

The salt-water fisheries of New Jersey are of greater value to the State. By the report of the New Jersey Fish and Game Commission we get the following information:

The Menhaden industry has four factories. The value of these factories was \$125,000 in 1904. The number of vessels used for them were several thousand, and twelve sailing vessels.

value \$130,000. There were employed 400 men, catching 32,000,000 menhaden, producing 1,500 barrels of oil and 2,500 tons of fertilizer. Besides what are taken by these companies, a fleet of steamers owned by a New York company caught many thousand on the coast of New Jersey.

The pound nets extend from Atlantic City to the Highlands of Navesink, and those on the Sandy Hook bay catch hundreds of thousands of menhaden, which are sold to the fishing smacks from Fulton Market, New York, or to the line fishermen along the shore for blue fish bait.

The following Natural History specimens have been received during the year :

Barn owl (female).  
 Black-billed cuckoo (male).  
 Whip-poor-will (female).  
 Purple martin (female).  
 Ipswich sparrow (male).  
 Turtle dove (female).  
 Two sharp-shinned hawks (male and female).  
 Night heron (female).  
 Downy woodpecker (female).  
 Purple martin (male).  
 Little yellow rail (male).  
 Least tern (young).

#### OTHER NATURAL HISTORY SPECIMENS.

1 large specimen of timber wolf, mounted.  
 1 large mounted lobster.  
 1 large mounted snapper turtle.  
 1 mounted mink.  
 4 mounted red foxes.  
 7 mounted ground-hogs.  
 1 alligator.  
 1 great squid.  
 1 devil fish.

#### EGGS AND NESTS.

Great blue heron, 1 nest, 2 eggs.  
 Fish crow, 1 nest.  
 Cooper's hawk, 1 nest.  
 Red-tail hawk, 1 nest.

## 18 REPORT OF NEW JERSEY STATE MUSEUM.

Red-shouldered hawk, 1 nest.  
Purple grackle, 1 nest.  
Red-winged black blackbird, 1 nest.  
Purple martin, 1 nest and eggs.  
1 flying squirrel nest.  
1 twin robin nest.  
100 sets of birds' eggs.

### GEOLOGICAL COLLECTIONS MADE FOR THE SCHOOLS.

The following is taken from the administrative report for 1905 of Mr. Henry B. Kummel, State Geologist:

Through the co-operation of the State Museum Commissioners it was possible to furnish nine schools with oak cases for the storage and display of the collections. The cases were those used by the Survey for its exhibit at St. Louis. The price of the cases was fixed at \$25 per set. The expense of preparing, labeling and packing the collections was \$25 each set, and they were furnished the schools at this figure, no charge being made for the original expense of collecting the material.

In May the Board of Managers authorized the preparation, from the duplicate specimens of the Survey, of collections of rocks, minerals, fossils and ores for distribution to the High Schools of the State. Thirty collections of 170 specimens each were made up. In each set the first 110 specimens were essentially identical, the balance being duplicates and odd specimens, of which there were not enough to go round. White cardboard trays were provided for all, except the powdered specimens, which were packed in small glass bottles, or cardboard boxes. Printed labels, giving the specimen number, its name, geological period, occurrences in the State and a brief description, were prepared.

The collections were arranged to illustrate the geology of New Jersey. Under each of the main divisions of geologic time, beginning with the oldest, were placed the common rock types, the important ores, the more striking minerals and examples of the common fossils. The character of the collections is well shown by the subjoined list of specimens.

Circular letters regarding the collections were sent to more than sixty high schools and academies, and in response to their applications sets have been sent to the following schools:

Westfield, Woodbridge, Kearny, Red Bank, Plainfield, Flemington, Montclair, Phillipsburg, Asbury Park, Long Branch, Bridgeton, Atlantic City, Morristown, Newark, Vineland, Hackensack, Rutherford, New Brunswick, Roselle Park, Belvidere, West Jersey Academy, State Normal School, Montclair Military Academy; total, 23. Seven sets are still undistributed, and can be had upon application and cost of preparation.

#### LIST OF SPECIMENS IN THE SCHOOL COLLECTIONS.

##### *Pre-Cambrian.*

- No. 1. Granite, variety pegmatite.
- No. 2. Granite or granitoid gneiss.
- No. 3. Gneiss—coarse grained.
- No. 4. Gneiss—fine grained.
- No. 5. Magnetite-bearing schist.
- No. 6. Tailings after separation of magnetite from No. 5.
- No. 7. Magnetite after concentration from No. 5.
- No. 8. Magnetite showing cleavage.
- No. 9. Massive magnetite.
- No. 10. Pyrrhotite or pyrite.
- No. 11. Graphite.
- No. 12. Pyroxene.
- No. 13. Biotite.
- No. 14. Crystalline limestone.
- No. 15. Dike rock in crystalline limestone.
- No. 16. Zinc ore, composed of franklinite, willemite and zincite, in un  
stone.
- No. 17. Franklinite after electrical concentration.
- No. 18. Willemite, separated from the limestone.
- No. 19. Limestone tailings from No. 16.
- No. 21. Calcite crystals.
- No. 22. Ophiolite.
- No. 23. Talc.
- No. 24. Hematite.
- No. 25. Aragonite.
- No. 26. Serpentine.
- No. 27. Brucite.
- No. 28. Nematite.
- No. 29. Marmolite.
- No. 30. Crysolite or Asbestos.
- No. 31. Molybdenite.

## 20 REPORT OF NEW JERSEY STATE MUSEUM.

- No. 32. Magnesite.
- No. 33. Hydromagnesite.

### *Paleozoic.*

- No. 34. Hardyston quartzite.
- No. 35. Quartzite.
- No. 36. Kittatinny limestone (blue).
- No. 37. Kittatinny limestone (pink).
- No. 38. Trenton limestone conglomerate.
- No. 39. Trenton limestone—cement rock.
- No. 40. Ground cement rock.
- No. 41. Portland cement clinker.
- No. 42. Portland cement.
- No. 43. Slickensided rock.
- No. 44. Hudson River slate.
- No. 45. Hudson River slate (weathered).
- No. 46. Eleolite—syenite.
- No. 47. Shawangunk (Oneida) conglomerate.
- No. 48. Decomposed Shawangunk sandstone.
- No. 49. Medina sandstone.
- No. 50. Decker Ferry limestone.
- No. 51. Rondout limestone.
- No. 52. Manlius limestone.
- No. 53. Coeymans limestone.
- No. 54. Gypidula (*Pentamerus*) *galæata*.
- No. 55. Esopus (*Cauda Galli*) grit.
- No. 56. Onondaga (*Corniferous*) limestone.

### *Mesozoic.—Triassic.*

- No. 57. Stockton arkose.
- No. 58. Lockatong argillite.
- No. 59. Brunswick shales.
- No. 60. Brunswick sandstone.
- No. 61. Baked shales.
- No. 62. Trap rock—intrusive.
- No. 63. Trap rock—extrusive.
- No. 64. Weathered trap rock.
- No. 65. Fossil fish.
- No. 66. Fossil fish.
- No. 67. Calcite crystals.
- No. 68. Stilbite crystals.
- No. 69. Natrolite crystals.
- No. 70. Native copper or copper ore.

### *Mesozoic.—Cretaceous.*

- No. 71. Fire clay.
- No. 72. Saggar clay.
- No. 73. Brick clay.
- No. 74. Pyrite balls.
- No. 75. Lignite.

- No. 76. Merchantville clay (brick).
- No. 77. Columbus sand.
- No. 78. Greensand marl.
- No. 79. Redbank sand.
- No. 80. Vincentown limesand.
- No. 81. Vincentown limesand.
- No. 82. Belemnite.
- No. 83. *Exogyra costata*.
- No. 84. *Gryphæa vesicularis*.
- No. 85. Other Upper Cretaceous fossils.
- No. 86. Vivianite.
- No. 87. *Terebratula Harlani*.
- No. 88. *Terebratella plicata*.
- No. 89. *Ostrea* larva.
- No. 90. Dinosaur bone (fragments).

*Cenozoic.*

- No. 91. Shark River marl—Eocene.
- No. 92. Fossil shell—genus *Venus*.
- No. 93. Miocene fossils.
- No. 94. Miocene sand.
- No. 95. Cohansey sand—Pliocene (?).
- No. 96. Cohansey sandstone—Pliocene (?).

*Pleistocene.*

- No. 97. Pensauken gravel.
- No. 98. Fossil shells—Genus, *Unio*.
- No. 99. Striated glacial pebble.
- No. 100. Conglomerate (late Pleistocene).
- No. 101. Glacial clay.
- No. 102. Clay stones.
- No. 103. Waterworn pebbles.
- No. 104. Infusorial earth.
- No. 105. Calcareous marl.
- No. 106. Peat.
- No. 107. Fresh-water mollusks.
- No. 108. Sea sand.
- No. 109. Marine mollusks.
- No. 110. Sea weed.

Nos. 111 to 170. In part duplicates of the above or other material, no two collections being alike.

THE EXHIBIT "HOW TO EXTERMINATE THE MOSQUITO."

This exhibit, since its return from the Louisiana Purchase Exhibition at St. Louis in 1903, has been re-arranged and installed in the large exhibit hall of the New Jersey State Museum.

## 22 REPORT OF NEW JERSEY STATE MUSEUM.

Some additions have been made to it, and it is arranged so it can be seen very much better than at St. Louis. The transparents are placed at windows, thus showing them much clearer, as it gives a good and uniform light.

This exhibit is visited by a large number of persons and admired by all.

### OTHER INSECTS ADDED TO THE MUSEUM DURING THE PAST YEAR.

There have been prepared by Prof. John B. Smith, the State Entomologist, the following boxes of insects, 39 to 57 inclusive. They are mounted and arranged as he only can do it:



# Catalogue of the Mosquito Exhibit.

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## MOSQUITO LIFE HISTORIES.

Box 1. The House Mosquito, *Culex pipiens* Linn.: figure of adult; figure of larva and details; 2 vials of male adults; 2 vials of female adults; 6 vials of larvæ in all stages; 2 vials of pupæ; 84 male adults pinned; 128 female adults pinned.

Box 2. The Little Black Mosquito, *Culex territans* Wlk.: figure of adult; figure of larva and details; 2 vials with male adults; 2 vials with female adults; 2 vials with pupæ; 6 vials with larvæ in all stages; 40 male adults pinned; 62 female adults pinned.

Box 3. The Unbanded Salt Marsh Mosquito, *Culex salinarius* Coq.: figure of larva and details; 2 vials with male adults; 2 vials with female adults; 6 vials showing larvæ in various stages; 2 vials with pupæ; 77 male adults pinned; 70 female adults pinned.

Box 4. The Woodland Pool Mosquito, *Culex canadensis* Theob.: figure of adult; figure of larva and details; figures of larval heads showing variation in maculation; 2 vials with male adults; 2 vials with female adults; 1 vial with eggs; 2 vials with pupæ; 5 vials with larvæ in various stages; 63 male adults pinned; 50 female adults pinned.

Box 5. The Swamp Mosquito, *Culex sylvestris* Theob.: figure of adult; figure of larva and details; figures of larval heads showing variation in maculation; 2 vials with male adults; 2 vials with female adults; 6 vials of larvæ in various stages; 2 vials with pupæ; 55 male adults pinned; 146 female adults pinned.

Box 6. The Brown Woods Mosquito, *Culex cantans* Meig., and the Golden-brown Mosquito, *Culex aurifer* Coq.: (1) *C. cantans*, figure of adult; figure of larva and details; 1 vial with pupæ; 2 vials with larvæ; 21 male adults pinned; 18 female adults pinned. (2) *C. aurifer*, figure of adult; figure of larva

and details; 1 vial with adults; 1 vial with larvæ; 1 vial with pupæ; 10 male adults pinned; 12 female adults pinned.

Box 7. The Tree-hole Mosquito, *Culex triseriatus* Say.; The Three-lined Mosquito, *Culex trivittatus* Coq., and The White-Dotted Mosquito, *Culex restuans* Theob.: (1) *C. triseriatus*, figure of larva and details; 1 vial with larvæ and pupæ; 8 male adults pinned; 8 female adults pinned. (2) *C. trivittatus*, figure of larva and details; 9 male adults pinned; 18 female adults pinned. (3) *C. restuans*, figure of adult with details of adult and larva; 2 vials with male adults; 2 vials with female adults; 1 vial with pupæ; 3 vials with larvæ in all stages; 24 male adults pinned; 27 female adults pinned.

Box 8. The Ring-legged Salt Marsh Mosquito, *Culex sollicitans* Wlk.: figure of larva and details; 2 vials with male adults; 2 vials with female adults; 6 vials with larvæ in all stages; 2 vials with pupæ; 66 male adults pinned; 92 female adults pinned.

Box 9. The Small Salt Marsh Mosquito, *Culex tæniorhynchus* Wied.; figure of adult; figure of larva and details; 2 vials with male adults; 2 vials with female adults; 1 vial with eggs; 1 vial with pupæ; 5 vials with larvæ in various stages; 63 male adults pinned; 70 female adults pinned.

Box 10. The Brown Salt Marsh Mosquito, *Culex cantator* Coq.: figure of adult; figure of larva and details; 2 vials with male adults; 2 vials with female adults; 2 vials with pupæ; 6 vials with larvæ in various stages; 44 male adults pinned; 101 female adults pinned.

Box 11. Salt Marsh Mosquitoes: 3 figures of larval heads of *Culex sollicitans*, 3 of *C. tæniorhynchus* and 3 of *C. cantator* showing extent of maculation in each species; 1 vial of larval heads of *sollicitans*; 1 vial of larval heads of *tæniorhynchus*; 1 vial of larval heads of *cantator*; mosquito eggs on lint; 4 vials of *sollicitans* adults parasitized by *Agamomeris culicis* Stiles, and also worms dissected out; 3 vials of *sollicitans* larvæ attacked by disease; 1 vial with female *sollicitans* abdomens distended with eggs; 1 vial with female *cantator* abdomens distended with eggs.

Box 12. *Anopheles maculipennis* Meig., and *Anopheles punctipennis* Say.: (1) *A. maculipennis*, figures of male and female

adults; 1 vial with male adults; 1 vial with female adults; 1 vial with pupæ; 2 vials with larvæ; 35 female adults pinned. (2) *A. punctipennis*, figure of adult; figure of larva and details; 1 vial with male adults; 1 vial with female adults; 1 vial with pupæ; 2 vials with larvæ; 30 female adults pinned.

Box 13. *Anopheles crucians* Wied.: figure of adult; figure of eggs; figures of pupæ showing differences between *Anopheles* and *Culex*; figure of larva and details; 4 vials with female adults; 2 vials with pupæ; 4 vials with larvæ; 93 female adults pinned.

Box 14. The Fringe-legged Mosquito, *Psorophora ciliata* Fabr.: figure of adult; figure of larva and details; 1 vial with male adults; 1 vial with female adults; 2 vials with pupæ; 2 vials with larvæ; 11 male adults pinned; 40 female adults pinned.

Box 15. The Pitcher-Plant Mosquito, *Wyeomyia smithii* Coq.: figure of larva and details; 1 vial with male adults; 2 vials with female adults; 1 vial with eggs; 1 vial with pupæ; 4 vials with larvæ in all stages; 3 vials with the leaves of pitcher plants; 50 adults representing both sexes.

#### MOSQUITO ENEMIES.

Box 16. Some Salt-Marsh Minnows: *Cyprinodon variegatus*, 3 vials containing 11 specimens; *Fundulus majalis*, 3 vials containing 6 specimens; *Fundulus heteroclitus*, 3 vials containing 5 specimens; 1 vial with 2 specimens of *Fundulus majalis* and 1 specimen of *Fundulus heteroclitus* showing differences in banding.

Box 17. Coast Line Minnows: *Menidia notata*, 3 vials containing 13 specimens; *Gambusia affinis*, 3 vials containing 11 specimens; *Mugil curena*, 2 vials containing 6 specimens; *Lucania parva*, 2 vials containing 9 specimens.

Box 18. Some Fresh Water Fishes: *Fundulus diaphanus*, 2 vials containing specimens; common gold fish, 2 vials containing specimens; little sticklebacks, 2 vials containing specimens; Roach or Shiner, 3 vials containing specimens.

Box 19. Diving Beetles and their Larvæ: *Dytiscus verticalis*, 3 vials with larvæ and 18 beetles; *Graphoderus liberus*, 14 beetles;

*Thermonectes basilaris*, 12 beetles; *Acilius semisulcatus*, 2 vials with larvæ and 16 beetles; *Rhantus binotatus*, 2 vials with larvæ and 16 beetles; *Agabus æruginosus*, 18 beetles; *Hydroporus modestus*, 81 beetles; *Coptotomus interrogatus*, 72 beetles; *Lacophilus maculosus*, 36 beetles; 3 vials of indetermined larvæ.

Box 20. Whirligig Beetles or Gyrinidæ and Aquatic Hemiptera or Water Bugs: *Dineutes discolor*, 24 specimens; *Dineutes vittatus*, 21 specimens; *Dineutes assimilis*, 28 specimens; *Benacus griseus*, 6 specimens; *Belostoma americana*, 6 specimens; *Notonecta variabilis*, 18 specimens; *Notonecta undulata*, 27 specimens; *Zaitha fluminea*, 18 specimens; *Corixa* species, 18 specimens; *Ranatra fusca*, 5 specimens; *Hygrotrechus remigis*, 14 specimens.

Box 21. Dragon Flies or Odonata: *Epiæschma heros*, 2 vials with larvæ and 3 adults; *Æschna constricta*, 2 vials with larvæ and 3 adults; *Anax junius*, 3 vials with larvæ and 3 adults.

Box 22. Dragon Flies or Odonata: *Pachydiplax longipennis*, 4 vials with larvæ and 7 adults; *Libellula basalis*, 2 vials with larvæ and 8 adults; *Libellula cyanea*, 1 vial with larvæ and 3 adults; *Libellula semifascia*, 1 vial with larvæ and 2 adults; *Mesothemis simplicicollis*, 1 vial with larvæ and 5 adults.

Box 23. Dragon Flies or Odonata: *Microthyria berenice*, 1 vial with larvæ and 6 adults; *Sympetrum rubicundulum*, 1 vial with larvæ and 6 adults; *Lestes rectangularis*, 2 vials with larvæ and 9 adults; *Ischnura verticalis*, 4 vials with larvæ and 12 adults; *Ischnura posita*, 3 vials with larvæ and 12 adults.

#### REPELLANTS AND LARVICIDES.

Box 24. Smokes and Smudges: 1 vial with Chinese punk; 5 packages Mosquitoons; 4 packages Lister's Fumigator; 4 Sulphur Candles; 1 vial of Pyrethrum; 1 vial of Datura Stramonium.

Box 25. Repellants: Vials of Oil of Pennyroyal; Oil of tar; Cottonseed oil; Oil of Citronella; Oil of Lavender. Cures: Camphenol; Phenol Sodique; Water of Ammonia; Tobacco; Bicarbonate of Soda.

Box 26. Larvicides: Vials of Crude Petroleum; Kerosene; Fuel Oil; Chloronaphtholeum; Phinotas Oil; Cresol; Creolin; Formalin; Permanganate of Potash; Flake Naphthalin.

## COLORED CHARTS.

1. Wing of a typical *Culex*; head of *Anopheles* showing arrangement of scales; 3 wing scales of *Anopheles*; group of 11 characteristic scales found on mosquitoes.

2. Larva of *Anopheles* from side and above; head from side and anal segments of larva; antennæ of two species showing differences; a mandible, maxillary palpus and a mentum of larva.

3. Resting position of *Culex sollicitans* and *Anopheles maculipennis*; male antennal joint, female antennal joint, tip of beak with lancets, male anterior claw, female anterior claw and clasper of genitalia of *Culex pipiens*.

4. A pupa of *Culex* and *Anopheles* showing differences.

5. *Anopheles* in the act of biting and the mosquito digestive system.

6. Stomach of *Anopheles* showing zygotes of the malarial organism on the surface; two cross sections showing zygotes in position on the surface of the stomach.

7. *Anopheles* salivary glands: one entire, one longitudinal section and one cross section of set of glands, and a cross section to show the blasts or sporozoites in position in the gland.

8. Head and mouth structures of *Anopheles maculipennis*: entire head of female from side; entire head of male from above; head of female showing how lancets rest in the tip of the beak; female labium, palpus and palpifer with tips of lancinia and palpifer separate.

9. Larva of *Culex pipiens*; egg-boat of same on surface of water with young emerging; cluster of single eggs of same, separate; egg of *Anopheles*, 2 views; egg of *C. canadensis*, whole and with cap tipped by issuing larva; egg of *C. sollicitans*, 2 views; egg of *W. smithii*, whole and with cap tipped; egg of *P. ciliata*.

10 and 11. Twenty-seven figures illustrating the growth and development of the malarial parasite, the sexual stages, conjugation and also the vegetative or asexual reproduction.

12. The Yellow Fever Mosquito: showing the male from the side, female from above and anterior claw of each; larva at sur-

face of water, egg from side and top, and also 4 details of adult structure, 4 of larval structure and 2 of pupal structure.

13. Explanatory chart of the entire mosquito exhibit.

#### NEW INSECTS.

Box 39. Orthoptera. Crickets or Gryllidæ: Drawing showing file and scraper; drawing showing ovipositor; drawing of mouth parts; drawing of fore leg of mole cricket; *Æcanthus niveus*, 14 specimens; *Gryllus pennsylvanicus*, 12 specimens; *Gryllus abbreviatus*, 5 specimens; *Gryllotalpa borealis*, 7 specimens; *Nemobius fascinata*, 14 specimens; *Apithus agitator*, 12 specimens.

Box 40. Orthoptera. Cockroaches, mantids and walking sticks: *Tenodera sinensis*, 2 specimens and 2 egg masses; *Diapheromera femorata*, 15 specimens; *Phyllodromia germanica*, 32 specimens and 1 card with egg cases; *Periplaneta americana*, 5 specimens; *Inchoptera unicolor*, 7 specimens.

Box 41. Aquatic Hemiptera: One card with dissected *Benacus griscus*; drawing of the swimming leg of a *Notonecta*; *Benacus griscus*, 4 specimens; *Belostoma americana*, 4 specimens and one vial with eggs; *Zaitha fluminca*, 14 specimens; *Corixa* Sp. (small), 16 specimens; *Corixa* Sp. (large), 9 specimens; *Notonecta variabilis*, 28 specimens; *Hygroxtrechus remigis*, 6 specimens.

Box 42. Hemiptera. Cicadas: Drawing of front and side views of head; drawing of musical apparatus of *C. tibicen* and *C. septemdecim*, with the timbals of the latter drawn separately; *Cicada tibicen*, 13 adults and 12 larva; *C. marginata*, 8 specimens; *C. canicularis*, 5 specimens; *Tettigea hicroglyphica*, 14 specimens.

Box 43. Parasitica. The sucking lice: Large drawings of the crab louse, *Phthirius inguinalis*; body louse, *Pediculus vesimenti*; head louse, *Pediculus capitis*; hog louse, *Hæmatopinus urius*; card with drawing of antenna of hog louse, tarsal claws of hog louse, egg of crab louse and beak of body louse.

Box 44. Hemiptera-Heteroptera: Drawing of wing of a heteropterous insect; drawings of bed bug, egg, young from above

and below and male adult; head of a Reduviid; clasping fore-leg of *Phymata crosa*; *Prionidus cristatus*, egg mass, 8 specimens; *Sinea diadema*, 8 specimens; *Phymata crosa*, 12 specimens; *Acanthia lectularia*; *Brachrhynchus simplex*, 14 specimens; *Anasa tristis*, 14 specimens; *Lygæus turcicus*, 14 specimens; *Murgantia histrionica*, 14 specimens; *Nezara hilaris*, 7 specimens.

Box 45. Exotic Butterflies: *Leucothyris victorina*, 2 specimens; *Heliconia petiverana*, 4 specimens; *Heliconia telchinca*, 6 specimens; *Dircenna dcro*, 2 specimens; *Smyrnia bloomfieldii*, 4 specimens; *Cuidas cleobea*, 4 specimens.

Box 46. Exotic Butterflies: *Hebommoia glaucippe*, 4 specimens; *Papilio philolaus*, 4 specimens; *Megalura pteleus*, 4 specimens; *Victorina steneles*, 4 specimens.

Box 47. Exotic Butterflies: *Didona aganissa*, 2 specimens; *Papilio cphidamus*, 4 specimens; *Papilio polydamus*, 4 specimens; *Euptocita hegesia*, 2 specimens; *Papilio calcei*, 4 specimens; *Papilio polyzcalus*, 2 specimens; *Danaïs limniace*, 2 specimens.

Box 48. Hemiptera-Homoptera: Drawings of a larva and a male Coccid; *Lecanium tulipifera*, 1 card; *Pulvinaria innumerabilis*, 1 card; the apple plant louse, drawing of a winged adult and eggs, 2 vials showing lice on leaves, 1 vial with eggs on twig; *Telamona amphelopsides*, 14 specimens; *Pæciloptera septentriionalis*, 14 specimens; *Diedrocephala mollipes*, 14 specimens; *Amphiscepa bivittata*, 14 specimens; *Empoasa mali*, 14 specimens.

Box 49. Coleoptera. The ground and tiger beetles: Drawing of larvæ of *Cicindela*; plaster cast of a burrow of a Cicinelid larva; *Cicindela dorsalis*, 12 specimens; *C. vulgaris*, 12 specimens; *C. generosa*, 12 specimens; *C. repanda*, 12 specimens; *C. punctulata*, 12 specimens; *C. sexguttata*, 10 specimens; *Calosoma scrutator*, 5 specimens; *Carabus limbatus*, 7 specimens; *Harpalus caliginosus*, 7 specimens; *Galerita janus*, 9 specimens; *Anisodactylus carbonaria*, 12 specimens.

Box 50. Coleoptera. Some water beetles: Drawing of mouth parts of a beetle; of swimming leg and antenna of *Gyrinus*, and leg of a male *Dytiscid* showing suckers; *Hydrophilus triangu-*

*laris*, 5 specimens; *Hydrocharis obtusatus*, 14 specimens; *Hydrophilus glaber*, 18 specimens; *Hydrophilus nimbatus*, 18 specimens; *Coptotomus interrogatus*, 30 specimens; *Lacophilus maculosus*, 27 specimens; *Bidessus affinis*, 18 specimens.

Box 51. Coleoptera. The lady-bird beetles: *Similia misella*, picture card showing larva, pupa and beetles, 23 specimens; *Hippodamia glacialis*, 14 specimens; *Adalia bipunctata*, picture card showing larva, pupa and adult, 0 specimens; *Cycloneda munda*, 7 specimens; *Chilocorus similis*, picture card showing all stages from egg to adult, 54 specimens; *Megilla fuscilabris*, picture card showing larva, pupa and adult, 26 specimens; *Coccinella novemnotata*, 14 specimens; *Epilachna borealis*, picture card showing adult larva and cross section of larva, 16 specimens *Analis 15-punctata*, 7 specimens.

Box 52. Coleoptera. Stag-beetles and flower beetles. *Lucanus dama*, drawing of antenna, 14 specimens; *Passalus cornutus*, 12 specimens; *Lachnosterna fusca*, drawing of legs, 11 specimens; *Ligurus relictus*, 7 specimens; *Polyphilla variolosa*, 7 specimens; *Xyloryctes satyrus*, 5 specimens; *Strategus antæus*, 5 specimens; *Allorhina nitida*, picture card showing larva, pupa and adult, 8 specimens; *Euphoria inda*, 14 specimens; *Trichius piger*, 18 specimens.

Box 53. Coleoptera. Clavicorns: *Silvanus surinamensis*, picture card showing larva, pupa and adult, 28 specimens; *Lænophaus pusilla*, 14 specimens; *Typhora fumata*, 14 specimens; *Tomarus pulchellus*, 14 specimens; *Brontes dubius*, 14 specimens; *Anthrenus scrophulariæ*, picture card showing larva from above and below, pupa and adult, 36 specimens; *Dermestes lardarius*, 8 specimens; *Dermestes frischii*, 8 specimens; *Trogoderma tarsale*, 9 specimens; *Attagenus piccus*, 9 specimens; *Saprinus pennsylvanicus*, 14 specimens; *Saprinus assimilis*, 14 specimens; *Saprinus fraternus*, 14 specimens; *Ips fasciatus*, 14 specimens; *Omosita colon*, 18 specimens; *Pallodes pallidus*, 14 specimens.

Box 54. Coleoptera. The metallic wood-borers, lantern flies and click beetles: *Chalcophora virginicensis*, 6 specimens; *Anthaxia viridifrons*, 27 specimens; *Dicra divaricata*, 7 specimens; *Chrysobothris femorata*, 16 specimens; *Agrilus ruficollis*, 16 specimens; *Calopteron reticulatum*, 8 specimens; *Ellychnia corrusca*,



8 specimens; *Pyropyga decipiens*, 16 specimens; *Photuris frontalis*, 8 specimens; *Photuris pennsylvanicus*, 8 specimens; *Chauliognathus pennsylvanicus*, 8 specimens; *Alaus oculatus*, 5 specimens; *Elatér rubricollis*, 14 specimens; *Monocrepidius vespertinus*, 14 specimens; *Melanotus communis*, 14 specimens; *Asaphes memnonius*, 6 specimens.

Box 55. Coleoptera. The flower beetles: *Canthon lævis*, 12 specimens; *Copris minutes*, 14 specimens; *Copris carolina*, drawing of antenna, 4 specimens; *Phancus carnifex*, 7 specimens; *Ontophagus pennsylvanicus*, 14 specimens; *Macroductylus subspinosus*, picture card showing larva, pupa, adult and structural details, 36 specimens; *Aphodius finctarius*, 12 specimens; *Trox scabrosus*, 7 specimens; *Serica sericea*, 14 specimens; *Stringoderma arboricola*, 14 specimens; *Anomala lucicola*, 16 specimens; *Pelidnota punctata*, 6 specimens; *Cotalpa lanigera*, 6 specimens.

Box 56. Coleoptera. The carrion beetles, burying beetles and rove beetles: *Necrophorus americana*, drawing of front leg, 4 specimens; *Necrophorus orbicollis*, 7 specimens; *Necrophorus marginata*, 7 specimens; *Necrophorus tomentosus*, drawing of antenna, 12 specimens; *Creophilus villosus*, 18 specimens; *Sistotrophus cingulatus*, 8 specimens; *Staphylinus maculosus*, 8 specimens; *Staphylinus violaceus*, 8 specimens; *Silpha americana*, 9 specimens; *Silpha surinamensis*, 10 specimens; *Silpha noveboracensis*, 14 specimens; *Silpha inaequalis*, drawing of antenna, 12 specimens.

Box 57. Lepidoptera. The Gypsy Moth and Brown-tail Moth: *Ocneria dispar*, 5 egg masses, 8 single eggs, 16 brown larvæ representing all stages, 4 ♂ pupæ, 5 ♀ pupæ, 11 ♂ adults, 12 ♀ adults; *Euproctis chrysorrhæa*, 5 winter nests, 10 blown larvæ representing all stages, 5 ♂ adults, 5 ♀ adults.

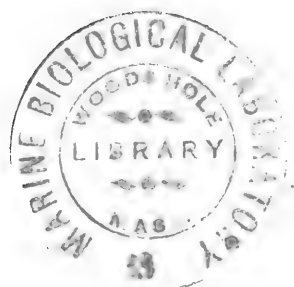


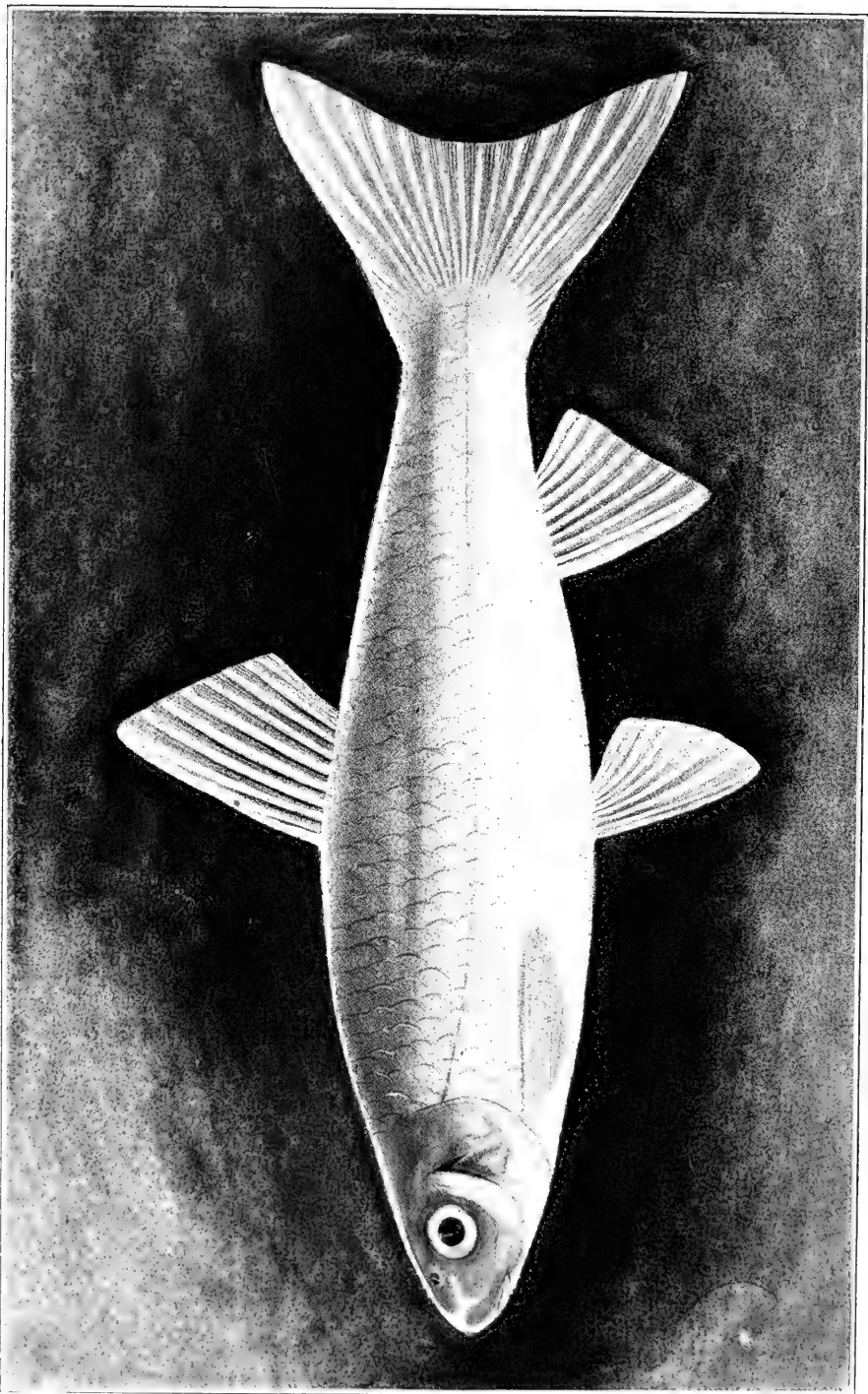
## Financial Report.

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William H. Werner, mounting specimens (in last year's bill),....	\$8 49
Ernest H. Short, nest and eggs, .....	24 51
U. S. Express, .....	27 18
John A. Grossbeck, mounting insects, .....	50 00
John A. Grossbeck, mounting insects, .....	50 00
John W. Bryant, white squirrel, .....	10 00
H. B. Kümmel, bill for work on hadrosaurus, .....	22 91
Edmund Heaton, work in museum, .....	15 00
Ernest H. Short, nest and eggs, .....	14 60
Jacob C. Cassell, glass globes and stands, .....	38 65
Crosby & Co., mounting fish, .....	42 10
Crosby & Co., balance on mounting fish, .....	2 50
Jacob C. Cassell, bottles for fish egg specimens, .....	6 99
F. J. Earl & Son, carting, .....	1 93
Adams Express Company, .....	1 60
Postage, Alex. Yard, P. M., .....	40 00
S. R. Morse, cash paid for foxes and other specimens,.....	14 50
J. B. Smith, insect, completion of mosquito exhibit, .....	50 00
August C. Hammer, five glasses for large pictures,.....	14 50
New Jersey School Furniture Co., one set of cabinets,.....	241 00
Wm. H. Werner, 11 square oak cases with glass sides,.....	110 00
Wm. H. Werner, for mounting specimens and other work,.....	171 15
Library Bureau, filing case cards and printing, .....	78 83
One set "Nature Library," three-quarter morocco, 10 volumes,....	43 50
United States Express, .....	19 35
<i>State Gazette</i> , forms, etc., .....	10 25
Contract N. J. School Furniture Co., one set cabinets,.....	241 00
	\$1,350 54







Silvery Minnow. *Hybognathus nuchalis regius* (Girard).

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PART II.

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THE FISHES OF NEW JERSEY.

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By HENRY W. FOWLER,

Of the Academy of Natural Sciences of Philadelphia.

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## PREFACE.

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The present work is the result of a study of the fishes of the waters of the state of New Jersey. Its scope will then include a fair representative fish-fauna of the Atlantic seaboard of the Virginian fauna. All marine as well as fresh-water species are included, and the fact that the writer here records some which have never been positively known from New Jersey waters before, shows that our knowledge is not yet complete. A number of records have been given from time to time of rare or more unusual species. These of course are in need of verification, and are admitted on their face value purely for the sake of completeness. Fortunately, however, in a number of such cases I have been able to examine the original material and thus place beyond question the identifications.

In the classification of the higher groups I have followed the views of Dr. David Starr Jordan. The descriptions of the families, together with much of the information in the keys, are compiled from Dr. Jordan's various contributions to ichthyology, especially in collaboration with Dr. Charles H. Gilbert, Dr. Barton W. Evermann, Prof. J. O. Snyder, Mr. Edwin C. Starks and myself. These have been modified to suit my own purposes, and it is believed are, on the whole, as nearly accurate as our present knowledge will permit. In the case of genera which are only listed, I have followed some precedents already enunciated. Throughout keys are given which are believed to be natural. The description of each species has been based on a New Jersey example and was drafted directly from the particular specimen. It is believed that this course is better than a more hurried compilation of averages in measurements, etc., as the amount of time consumed in this report would not permit of more. However, it is hoped that the writer will be allowed to carry on more ex-

tensive work in the study of variation, faunal relations, etc., in the future. In the case of species not represented by specimens I have confined the account to a line or so of salient diagnosis with pertinent remarks. The vernaculars employed are those compiled from the various authors who have written on New Jersey fishes, together with such as I have gathered from fishermen, sportsmen, anglers and others. In the case of each species nearly complete references, or at least as far as I am now able to determine are given, so that one may have a complete knowledge of each as now known from our waters.

To the Academy of Natural Sciences of Philadelphia I am under great obligations for the use of its unexcelled collection of New Jersey fishes. It was in the laboratory of that institution that all of the species represented by specimens were drafted. Though the collecting of New Jersey fishes began in Le Sueur's time early in the last century, there are none of his specimens in the Academy at present. The next and most complete collections were made by Samuel Ashmead at Beesley's Point, the famous rendezvous for many of the older naturalists of the Academy. Most of the Ashmead collections are still extant and embrace many more species than found by Spencer F. Baird in 1854. However, some of Baird's specimens are also in the Academy. The collections of Dr. Charles C. Abbott, from near Trenton, are important and illustrate fairly well the fauna of that region. Subsequently Edward D. Cope visited the pine-barrens streams in the southern part of the state and made collections. Finally the writer has collected in many parts of the state with success, such as the Saddle River in Bergen County, various points along the Delaware River, Crosswicks Creek near Trenton, Rancocas Creek, Sea Isle City, Anglesea, Stone Harbor, Cape May, Ocean City, Great Egg Harbor River, Wading River, Atlantic City and elsewhere. Many notes were made in the field which are used in this report, especially those with reference to the color of fresh or living examples.

The writer is indebted to the State Museum of New Jersey and its able Curator, Mr. Silas R. Morse, for assistance in facilitating the work of the present report. To Dr. Charles C.

Abbott, of Trenton, for much of his interest and assistance, especially in consenting to go over the work on Delaware River fishes and advancing many important suggestions. To Dr. Barton W. Evermann, of the Bureau of Fisheries in Washington, D. C., for matter relative to this work. To Prof. Ulric Dahlgren, of Princeton University, for some information on New Jersey fishes. Further I am indebted to Dr. Abbott, Mr. Witmer Stone, Mr. Thomas D. Keim, Mr. David McCadden, Mr. William J. Fox, Mr. I. N. DeHaven, Mr. Paul Lorrilliere, Mr. S. P. G. Lindsay, Mr. W. S. Sutch, Mr. H. Walker Hand, and many others, for much assistance, especially in conducting fishing excursions. Of these I am sure many will long be remembered with pleasure. Mr. Hand has been exceptionally kind in forwarding nearly complete information of the more abundant fishes of Cape May and has always exerted himself to the utmost to make our trips in that region a success. Mr. Fox has made very fair collections of the fishes of Sea Isle City and kindly placed much information at my disposal. Mr. Keim has also helped in every way to make our New Jersey trips successful, some of which are the most important we have yet realized.

Special mention is here made of the permission extended by the Hon. Benj. P. Morris, President of the Fish and Game Commissioners of New Jersey, to the writer, to collect fishes with nets. This has been used in connection with his work on the large collections of fishes in the Academy of Natural Sciences of Philadelphia with most satisfactory results.

The figures used in this report are reproductions of those published in 1884 by Dr. G. B. Goode in his *Natural History of useful and aquatic animals*, in the Report of the Fishery Industry of the United States. Also a number are taken from Bull. U. S. Nat. Mus. No. 47, volume IV, comprising the figures to the *Fishes of North and Middle America* by Drs. D. S. Jordan and B. W. Evermann. Besides these I have added a few pen-drawings of my own.

In concluding I may state that few realize the imperfections of this work more than the writer, and though making no excuse

for such errors as may occur, it is trusted that they are at a minimum. It is hoped that it will be of use and value to those who may be interested in the subject and act as a stimulus to a further and more complete account in the near future.

HENRY W. FOWLER,  
*Academy of Natural Sciences of Philadelphia.*

December 1st, 1905.

# The Fishes of New Jersey.

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BY HENRY W. FOWLER.

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## INTRODUCTION.

New Jersey has a more extensive seaboard than any of the Middle Atlantic States in proportion to its area. It lies entirely on the Atlantic slope and intrudes its northwestern portion into the Appalachian province. The lower half of the state is low, sandy and covered with pine woods. From this it may be seen that three rather characteristic faunas exist, *i. e.*, a marine, a low land or pine-woods, and an alpine. The marine fauna is unquestionably the most important in every feature, either for its richness in forms or its great economic value. In fact it comprises by far the greater number of species known from the state, many of them of the greatest importance to the commercial world. While it may be said that many are regular visitors to our coast during the summer and others are only found or taken in abundance during the winter or cold weather, it is also true that some are residents. The marine fauna is well represented by the littoral shore-fauna of the Virginian. Of the deep-sea fauna off the New Jersey banks nothing much is known. Pelagic forms are likely to occur at any time and some of the more usual have already been recorded. Among the most interesting forms, however, are those which wander from the tropical waters in the Gulf Stream, sometimes even beyond our limits as far as Massachusetts. In fact many young fishes of different groups only known from their tropical habitats are distributed at times along the Atlantic coast of the United States in this way. Of the shore-fauna many forms occur in the inlets and salt ponds, sometimes

running well up into tide-water where it is fresh. Others never wander so far from salt water. From a naturalist's point of view the most interesting region is that of the dark cedar or pine-stained streams of the lower half of the state. In these usually still and quiet streams are correspondingly dull and quiet-mannered fishes. There are not many species represented, perhaps only a minnow or so, a darter, several small sunfish, a black cat-fish, pike, and several mud-loving fishes such as the sucker, mud minnow and mud sunfish. A noticeable feature of all these fish is that they are as a rule much darker than corresponding examples from the uplands, in fact they have been taken almost black in some cases. This deep pigment is probably due to the dark water in which they live as it does not appear to be associated further with any structural differentiation. The alpine or northwestern part of the state undoubtedly bears much in common with the more common upland fishes of the contiguous regions of Pennsylvania and New York, so far as has been determined. As much of our information concerning the various faunas is at present very incomplete, it is impossible to present a complete list of the fishes of all streams. I have, however, from time to time been enabled to make fairly representative lists of some of the streams and localities from which I know positively of the occurrence of the said species either from my own observation or that of others apparently reliable. As neither time or space will permit I am at present unable to go into a detailed discussion of this most interesting subject. I hope in the future, however, to present a more or less complete review of this work which will be still more valuable with additional research.

#### FAUNAL WORKS.

The first mention, so far as I can gather at present, of New Jersey fishes seems to be the interesting account quoted from Mahlon Stacy's letter of April 26th, 1680, by Dr. Charles C. Abbott. This was evidently from Trenton and gives but a few of the vernaculars, among which is "sheep's-heads," thought by Dr. Abbott to be the chub, *Semotilus*, but most likely were in reality *Catostomus commersonnii*. This letter, however, is very largely of interest as a historical feature.

SPENCER FULLERTON BAIRD.

1855. Report on the Fishes observed on the coasts of New Jersey and Long Island during the summer of 1854. <Ninth Annual Report, Smiths. Inst., 1854, pp. 317-352+337.

This is properly the first work on the fish-fauna of New Jersey, and will long stand among the first of its kind. As stated by Dr. Bean this was the first systematic account of marine fishes made by Baird and also the only one of its kind which has emanated directly from his pen. It was here that he originated the methods of observation of marine fishes which were long afterwards applied in his greater researches on behalf of the United States Government into the causes of the decrease of food-fishes and their propagation in the waters of the United States. The paper is the result of a six weeks' stay on the New Jersey coast, principally at Beesley's Point, and Long Island, New York. An account of the region is given, the vernaculars employed by the fishermen, and notes on the habits, occurrence, life, colors, etc., of each species. Baird was so fortunate at that time as to gain the good will of Messrs. Samuel and Charles Ashmead, who resided at Beesley's Point, and whose large collections from that place have found their way into the Academy of Natural Sciences of Philadelphia, where they have been studied by the present writer and embraced, such as are still extant, in the present report. Some of Baird's examples were also sent to that institution from the Smithsonian Institution many years ago and have also been examined in this connection.

Baird's paper was reprinted as a pamphlet with an index under the following title:

"Report of the Secretary of the Smithsonian Institution, on the Fishes of the New Jersey coast, as observed in the Summer of 1854, by Spencer F. Baird, Assistant Secretary, S. I. From the Ninth Annual Report of the Smithsonian Institution, for 1854, Washington, Beverly Tucker, Senate Printer, June, 1855. [8 vo, 40 pp.]

THOMAS BEESLEY.

1857. Catalogues of Zoological and Botanical productions of the county of Cape May. Catalogue of Fishes. Cape May, N. J., 1857, pp. 146-148.

This is merely a list compiled from Baird.

CHARLES CONRAD ABBOTT.

1860. Description of a new species of *Astroscopus*, Brev., in the Museum of the Academy of Natural Sciences of Philadelphia. <Proc. Acad. Nat. Sci. Phila., 1860 [Sept. 1860], p. 365, Pl. 7, and a correction, p. 479.

Description of a new species of *Chatoessus*, Cuv., from New Jersey. <L. c., pp. 365-366.

1861. Notes on the Habits of *Aphredoderus sayanus*. <L. c., 1861 [April, 1861], pp. 95-96.

On *Cyprinus corporal*is. Mitch., referring it to the genus *Semotilus* Rafinesque. <L. c., pp. 154-156.

On *Squalus americanus* Mitchell, referring it to the genus *Odontaspis*, Agassiz. <L. c., pp. 399-401.

1869. Catalogues of Vertebrate Animals of New Jersey. <Geology of New Jersey, 1868. Appendix. Fishes, pp. 806-830.

This is the most complete account of New Jersey fishes to-day, and though far from all one could wish has more features of value than Dr. Theodore Gill's rather severe censure of 1873 would imply. The work is only a list of the species with notes on their abundance, habits, etc., which in most cases was based on the author's own observations and the rarer or unusual forms recorded in the collections of the Academy of Natural Sciences of Philadelphia, a number of which the present writer has since examined himself. Many of the identifications were given to Dr. Abbott by Cope. The work is unfortunate in the uncorrected proof.

1870. Notes on Fresh-Water Fishes of New Jersey. <American Naturalist, IV, 1870 (March), pp. 99-117, figs. 30-33.

Mud-loving Fishes. <L. c. (September), pp. 385-391, figs. 86-87.

1871. Further Notes on New Jersey Fishes. <L. c. (February, 1871), pp. 717-720, fig. 163.

1874. Notes on the Cyprinoids of Central New Jersey. <L. c., VIII. 1874 (June), pp. 326-338, fig. 78.



This contains a description of a new species, *Alburnus amœnus*.

1878. Notes on Some Fishes of the Delaware River. <Rep. U. S. Fish Comm., 1875-76, pp. 825-845.

Published in the form of a letter to Baird and contains some interesting information concerning our fresh-water fishes.

1885. A Naturalist's Rambles about Home. New York. D. Appleton & Company, 1, 3 and 5 Bond street.

This contains a popular account of the fishes mostly in the vicinity of Trenton, see chapters 34-37, pp. 351-445. In the index is a list of the fishes of Mercer County, pp. 477-479.

ADDISON E. VERRILL.

1871. On the Food and Habits of Some of our Marine Fishes. <American Naturalist, V, 1871 (September), pp. 397-400.

Based largely upon a few days' stay at Great Egg Harbor in April of 1871.

EDWARD DRINKER COPE.

1883. The Fishes of the Batsto River, N. J. <Proc. Acad. Nat. Sci. Phila., 1883 (July 24th), pp. 132-133.

This short account gives a list of the fishes of this cedar-swamp stream. *Amiurus prosthistiis* is described as new.

1896. Fishes in isolated pools. <American Naturalist, XXX, 1896 (November), pp. 943-944.

An account of fresh-water fishes observed near Winslow.

TARLETON H. BEAN.

1888. Report on the Fishes observed in Great Egg Harbor Bay, New Jersey, during the summer of 1887. <Bull. U. S. Fish Comm., VII, 1887 (May 12th, 1888), pp. 129-152, with index, pp. 153-154, Pls. 1-3, figs. 1-19.

This valuable paper is a re-examination of the ground gone over by Baird in 1854, and adds much to our knowledge of the fishes of that most interesting region. Although some of Baird's species were not found, others are recorded for the first time from within the limits of the state. The figures and notes on young fishes are of special interest, some of these not having been previously described.

JULIUS NELSON.

1890. Descriptive Catalogue of the Vertebrates of New Jersey. <Rep. Geol. Surv., II, pt. 2, Min. Bot. Zoöl., 1890, pp. 1-824, Fishes, pp. 657-776.

A compiled descriptive account of each species, mostly from Drs. Jordan and Gilbert's "Synopsis," which may have reference to material collected anywhere except within our limits, with quoted notes from Dr. Abbott's paper of 1869. Many species are included purely on account of their known range along Atlantic shores, though never as yet having been definitely recorded from within the state's limits. The adjustment of some of Dr. Abbott's references is also at times at variance with what is now known of the species.

H. F. MOORE.

1894. List of Fishes collected at Sea Isle City, New Jersey, during the summer of 1892. <Bull. U. S. Fish Comm., XII, 1892 (February 28th, 1894), pp. 357-364.

This contains a list of 61 species made by the writer while attached to the marine Biological Laboratory of the University of Pennsylvania, at Sea Isle City. All the fish taken at the laboratory from June 25th to September 1st were examined and reported on.

HUGH M. SMITH.

1894. Economic and Natural History Notes on Fishes of the Northern Coast of New Jersey. <Bull. U. S. Fish Comm., XII, 1892 (March 10th, 1894), pp. 365-380.

This contains a most interesting and important account of the abundance, movements, etc., of some of the fishes found on the New Jersey coast which relate more particularly to the region north of Barnegat Inlet, based chiefly on a study of the pound-net fishery. Interesting vernaculars heard in the region are given.

## EUGENE SMITH.

1897. The Fishes in the Fresh and Brackish Waters in the Vicinity of New York City. <Abstract of Proc. Linn. Soc. N. Y., 1896-97, No. 9, pp. 9-51.

This supplies most all of our knowledge of the fishes of north-eastern New Jersey. The region in our limits under discussion is embraced in the Hackensack River valley, the main valley of the Passaic River with its northern and eastern branches, and part of the region tributary to the Navesink River. Unfortunately for our present use special localities under each species are not always given.

## HENRY W. FOWLER.

1900. Note on *Ameiurus prosthistius*. <Proc. Acad. Nat. Sci. Phila., 1900 (July 10th), pp. 352-355.

1903. The occurrence of three interesting Fishes on the New Jersey Coast. <Science, N. S., Vol. XVII, April 10th, 1903, pp. 594-595.

1904. Description of a new race of *Notropis chalybæus* from New Jersey. <Proc. Acad. Nat. Sci. Phila., 1904 (April 7th), pp. 239-240, Pl. 17, with 2 figures.

## BARTON W. EVERMANN.

1902. Lake Mashipacong. <Recreation, April, 1902, pp. 291-293.

This is a short account of the lake with a list of the fishes collected in October, 9 species in all, with notes. I am indebted to Dr. Evermann for the reference to this paper.

## **Class CYCLOSTOMES.**

### The Lampreys.

Naked eel-shaped animals, known by the absence of jaws, limbs and ribs, also without coat-of-mail, and by the presence of a brain.

### **Family PETROMYZONIDÆ.**

#### The True Lampreys.

Body compressed behind. Eyes well developed in adult, rudimentary in young. Mouth partly inferior, disk-like and formed for sucking. Lips, fringed. Horny teeth in adult resting on papillæ in mouth, though in young toothless. Nostril on top of head close in front of eyes. Intestine with spiral valve. Eggs small. Dorsal fin somewhat notched.

Found attached by means of the sucker-like mouth to other fishes on which they feed by scraping off the flesh with their horny teeth. Ascending streams in the spring to spawn.

#### Genus PETROMYZON Linnæus.

#### The Lampreys.

##### **Petromyzon marinus Linnæus.**

Lamprey. Sea Lamprey. Lamper Eel. River Lamprey. Green Lamprey. Shad Lamprey. Nine Eyes.

Head, to first gill opening, 9; depth 11. Body elongate with trunk compressed. A median ridge down back to dorsal. Head broad. Snout long. Eye circular, without lids, and a little less than last third in space between tip of snout and first gill-opening. Mouth large and with fringed lips. Teeth conic, placed in oblique series with innermost largest and superior of which are

bicuspid. Two pairs of lunate pectinate lingual teeth, and serrations of anterior pair confluent. Two dorsals, posterior larger. Caudal small and rounded. Color when fresh deep or blackish-olive above mottled with dirty brownish. Lower surface of body brownish tinted with dull slaty and dull golden, especially on belly and about gill-openings. Lips, or edge of disk, grayish. Inside of disk fleshy, teeth all pale or very dilute yellowish. Iris deep brownish, ring adjoining narrowly pale yellowish. From eye back and in each interbranchial space a rather broad dusky shade. Dorsal fin dusky-olive or blackish, margin of first rather broadly pale or whitish. Margin of second dorsal indistinctly pale. Length 22 inches. Near Sewell in a small stream above the Delaware tide-water called Chestnut Branch, tributary to Mantua Creek, May 27th, 1904.



Lamprey. *Petromyzon marinus* Linnaeus.

According to the fishermen of the Great Egg Harbor River it is occasionally taken in tide-water. In the Delaware it is abundant mostly during the spring run of shad, and I have seen examples which have burrowed nearly through adult shad. In small creeks I have only found young examples though, as in the case of the one described, the large ones do occur. Possibly the brook lamprey occurs within the limits of the state though as yet I have no material. By the Delaware River fishermen the flesh of the lamprey is considered poisonous and therefore not to be eaten. A large example was found near Beverly during April of 1905, on the river beach, where it had rotted. They were said to have been frequently taken in this region and found mostly attached to the gills of the shad. Several large ones were

also seen at times swimming about the Beverly wharf. Other examples examined were taken at Atlantic City and Beesley's Point. Prof. Dahlgren reports it from Princeton.

*Petromyzon marinus* Abbott, Geol. N. J., 1868, p. 830.—Abbott, Nat. Rambles, 1885, p. 479.

*Petromyzon americanus* Le Sueur, Tr. Am. Philos. Soc. Phila., I, 1818, p. 383.—Abbott, Geol. N. J., 1868, p. 830.—Abbott, Rep. U. S. F. Com., 1875-76, p. 827.

*Petromyzon nigricans* Abbott, Geol. N. J., 1868, p. 830.—Abbott, Amer. Nat., 1870, p. 719.

*Ichthyomyzon appendix* Abbott, Geol. N. J., 1868, p. 830.

## Class PISCES.

### The Fishes.

Cold-blooded aquatic vertebrates which breathe by means of gills not purse-shaped, but attached to cartilaginous or bony gill-arches. Skull with lower jaw. Limbs developed as fins, rarely wanting. Body usually covered with scales, bony plates or horny appendages, sometimes naked. Median line of body with one or more fins composed of cartilaginous rays joined by membrane.

### Key to the sub-classes.

a. Gill-opening 5 to 7 slits on each side of pharynx.

ELASMOBRANCHII

aa. Gill-opening single on each side.

ACTINOPTERI

## Sub-Class ELASMOBRANCHII.

### Shark Like Fishes.

Membrane bones of head undeveloped, except sometimes rudimentary opercle. Skeleton cartilaginous. Skull without sutures. No air-vessel. Intestine with a spiral valve. Arterial bulb with 3 series of valves. Optic nerves united by a chiasma. Cerebral hemispheres united. Gills not free, attached to skin by outer

margin. Ova few and large, impregnated and sometimes developed internally. Embryo with deciduous external gills. Tail heterocercal. Ventral fins abdominal. Male with large intromittent organs or claspers attached to ventral fins. Skin naked or covered with minute rough scales, sometimes with spines.

*Key to the orders and families.*

- a. ASTEROSPONDYLI. Anal fin present.
  - b. No nictitating membrane to eye.
    - c. Upper caudal lobe moderate, though much longer than lower. CARCHARIIDÆ
    - cc. Upper caudal lobe long as rest of body. ALOPIIDÆ
    - ccc. Caudal lunate, lower lobe not much shorter than upper; side of tail with a keel.
      - d. Gill-openings rather large; teeth large. LAMNIDÆ
      - dd. Gill-openings very large, nearly meeting above and below; teeth small. CETORHINIDÆ
  - bb. Eye with nictitating membrane.
    - e. Head normal. GALEIDÆ
    - ee. Head kidney or hammer-shaped, much wider than long. CESTRACIONTIDÆ
- aa. TECTOSPONDYLI. No anal fin.
  - f. (*Cyclospondyli*.) Gill-openings lateral; each dorsal with a spine. SQUALIDÆ
  - ff. (*Batoidei*.) Gill-openings ventral.
    - g. Tail with 2 dorsals; no serrated caudal spines.
      - h. Snout saw-like; body shark-like. PRISTIDÆ
      - hh. Snout not saw-like; disk ending abruptly at base of tail. RAJIDÆ
    - gg. Tail slender, with one or no dorsal, and usually with one or more serrated spines.
      - i. Pectorals uninterruptedly confluent with snout; teeth small. DASYBATIDÆ
      - ii. Pectorals divided, leaving detached cephalic fins on snout.
        - j. Teeth large, flat and tessellated. MYLIOBATIDÆ
        - jj. Teeth small, flat or tubercular; size enormous, largest of rays. MOBULIDÆ

**Family CARCHARIIDÆ.**

**The Sand Sharks.**

Body rather elongated. Snout sharp. Mouth wide, crescent-shaped. Teeth large, long, narrow, subulate, most with 1 or

2 small cusps at base, and edges entire. Gill-openings rather large, all in front of pectorals. Spiracles minute, pore-like. Two dorsals, moderate and subequal. Anal similar. First dorsal well behind pectorals. Caudal with notch towards its tip. No caudal keel. Pectorals rather short.

Voracious sharks of moderate size chiefly of the Atlantic. Represented by a single genus and species on our coast.

### Genus *CARCHARIAS* Rafinesque.

#### The Sand Sharks.

##### *Carcharias littoralis* (Mitchill).

Sand Shark. Shark. Shovel Nose Shark.

Head rather broad and blunt. Tip of snout nearly 3 times in advance of anterior margin of orbit as posterior margin of orbit is anterior to angle of mouth. Snout pointed and protruding. Margin of upper jaw somewhat distinctly defined but not prominently. Teeth with a single cusp on either side, but 1 occasionally wanting. First tooth of both jaws smaller than adjoining ones. In upper jaw on each side 2 very long teeth, following, and at either side of these another pair somewhat smaller than 2 teeth increase somewhat in length and the remainder gradually decrease. In lower jaw teeth decrease gradually from first pair. Nostrils well forward; near extremity of upper jaw. First dorsal in advance of ventrals a space equal to about half length of base of first dorsal. Caudal rather short and broad. Length 8 feet 9 inches. Beesley's Point. (Abbott.)

Although I have never seen any New Jersey examples it has been reported to me from Stone Harbor. Possibly the shovel nose shark of the fishermen is this species.

Dr. Dahlgren believes there may prove to be two forms of this species, one ranging but several feet in length and the other large. He has seen examples in the New York Aquarium from the New Jersey coast.

*Carcharias littoralis* Moore, Bull. U. S. F. Com., XII, 1892, p. 358.



*Odontaspis americanus* Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 400.—Abbott, Geol. N. J., 1868, p. 828, from same example.

### Family ALOPIIDÆ.

#### The Thresher Sharks.

Body moderately elongate. Snout rather short. Mouth crescent-shaped. Teeth equal in both jaws, moderate-sized, flat, triangular, and not serrated. Third tooth of upper jaw on each side much smaller than others. Gill-openings moderate, last above root of pectoral. Spiracles just behind eye, minute or absent. First dorsal large, midway between pectorals and ventrals. Second dorsal and anal very small. A pit at root of caudal and a notch on upper lobe near its tip. No caudal keel. Ventrals rather large. Pectorals very large, falcate.

A single species in most seas.

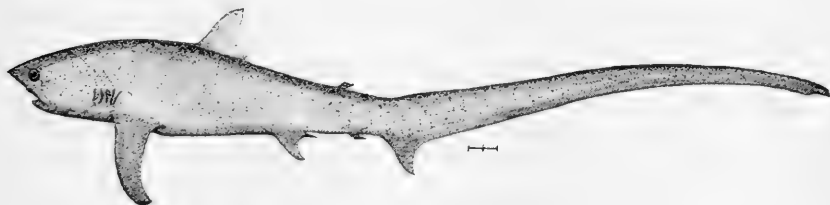
#### Genus ALOPIAS Rafinesque.

#### The Thresher Sharks.

#### *Alopias vulpes* (Gmelin).

#### Thresher Shark. Fox Shark.

This shark may easily be known at sight from any of our fishes by the long tail.



Thresher Shark. *Alopias vulpes* (Gmelin).

It is included on Dr. Abbott's authority, who states it to be abundant and frequently taken on hooks baited for other fish. I have never seen or heard of any New Jersey examples.

*Alopias vulpes* Abbott, Geol. N. J., 1868, p. 828.

## Family LAMNIDÆ.

## The Mackerel Sharks.

Body stout. Mouth wide. Gill-openings wide, all in front of pectorals, and entirely lateral, or not extending under the throat. Spiracle minute or absent. First dorsal large. Second dorsal and anal small. Tail slender and pit at root of caudal. Pectorals large. Ventrals moderate.

Numerous fossil species are known. In this family, the muscular system and dentition reaches its highest degree of specialization known among sharks.

*Key to the genera.*

- a.* Teeth without basal cusps, long, flexuous, acute.  
*aa.* Teeth each with 1 or 2 basal cusps.

ISURUS  
 LAMNA

## Genus ISURUS Rafinesque.

## The Porbeagles.

*Isurus dekayi* (Gill).

## PLATE I.

## Mackerel Porbeagle.

Body cylindrical, fusiform. A carina on each side of caudal peduncle, highest in middle. A deep indentation in upper and lower surfaces of caudal peduncle in shape of horseshoe. Head small, with blunt pyramidal snout. Eyes moderate, lateral. Teeth various, in 3 to 5 rows. Anterior mandibular teeth largest, irregularly lanceolate, external and sometimes internal edge rounded and waved. Margins with finely elevated crest, smooth, absolutely serrate under lens, flattened in front, and rounded, approaching a triangular form behind. Occasionally recurved, tips turning slightly outwards. Front upper teeth long,

pointed, flattened on anterior surfaces and rounded behind. Lateral teeth small, compressed, triangular, and so much crowded behind as almost to resemble tuberculated molars. On palate a rounded patch offering asperities to the hand when moved forward. Across roof of mouth a strong membranous fold. Nostrils doubly curved, sublateral. Posterior branchial aperture farthest from its antecedent. Under a lens the surface exhibits numerous minute plates, each with three parallel longitudinal elevated lines, producing a roughness when the hand is moved towards head. On surface of head four series of punctures on each side, commencing nearly opposite posterior margins of orbits, dilating and extending to within an inch of tip of snout. Immediately before eyes a large patch of similar punctures extending slightly beyond nostrils. On under side of snout a triangular patch of similar punctures. A regularly curved series of punctures from end of carina concurrent with back and ending just anterior to origin of first dorsal. All these punctures apertures of mucous ducts filled with a transparent jelly. Skin at posterior bases of dorsal and pectorals eroded by parasite. First dorsal quadrilateral, higher than long, upper margin excavated, and lower angle pointed. Second dorsal very small, oblong, lower angle behind ending in a prolonged point. Anal small, similar to second dorsal, slightly posterior or midway between ventral and base of caudal. Caudal deeply lunate, lobes slightly unequal. Pectoral long, pointed, deeply concave on posterior margin, base small. Ventral quadrilateral, and length of base twice the height. Color in life said to be deep bottle-green, afterwards generally dark slaty, lighter beneath. Tongue mottled with black. Length 10 feet 2 inches. In the harbor of New York, October, 1840, and near the lightships stationed off Sandy Hook. (DeKay.)

I have no other records or information concerning this shark  
*Isuropsis dekayi* Gill, An. Lyc. Nat. Hist. New York, VII. Dec. 1861, p. 409. Based on *Lamna punctata* DeKay, N. Y. Fauna, Zoöl., III, 1842, p. 352, Pl. 63, figs. 206-7.

? *Isuropsis glaucus* Abbott, Geol. N. J., 1868, p. 828.

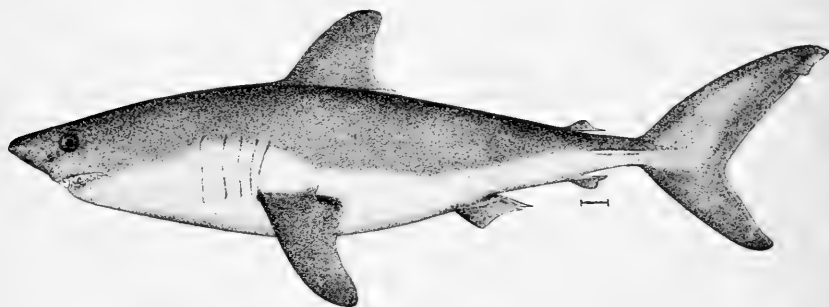
Genus LAMNA Cuvier.

The Mackerel Sharks.

*Lamna cornubica* (Gmelin).

Mackerel Shark.

A large fierce pelagic shark reaching a length of 10 feet. It may be known from the preceding species chiefly by the teeth, which are sharp with entire edges, somewhat triangular and mostly with a small cusp on each side at the base.



Mackerel Shark. *Lamna cornubica* (Gmelin).

A single example from Townsend's Inlet, taken by Capt. J. D. Cassey, of which only the jaws were preserved, has been examined. About Cape May sharks, evidently answering the description of this species, have been reported as of less frequent occurrence than others. One of these was taken by Mr. D. M. Barringer during the summer of 1899 on a 17-ounce rod which was said to have weighed about 260 pounds. It measured 8 feet 4 inches in length and when opened contained pieces of butter fish, *Trachinotus*, menhaden, *Brevoortia* and two or three crabs. Some years back another was reported from a pound-net with 3 remoras attached. It does not appear likely that the accounts of these examples could refer to the *Isurus dckayi*.

? *Isuropsis glaucus* Abbott, Geol. N. J., 1868, p. 828.

**Family CETORHINIDÆ.**

## The Basking Sharks.

Mouth moderate. Teeth numerous, conical, without cusps or serratures. Gill-openings all in front of pectorals. Spiracles very small, above corners of mouth. Brain very small. First dorsal large, midway between pectorals and ventrals. Second dorsal and anal small. Pectorals and ventrals large.

Sharks of immense size, the largest of living fishes, pelagic, and inhabiting the northern seas. A single genus with one species rarely straying to our shores.

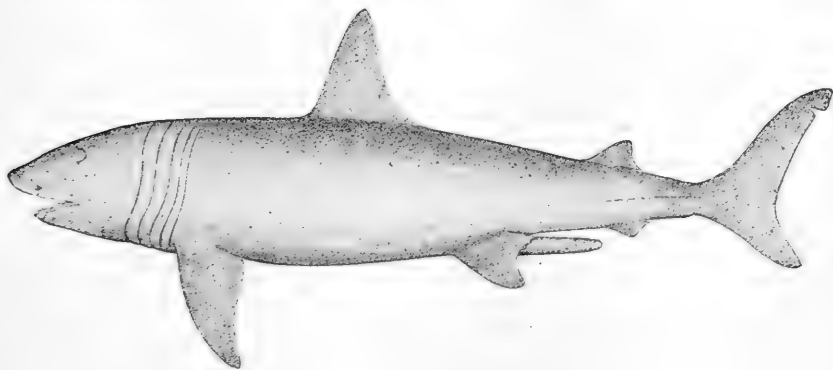
## Genus CETORHINUS Blainville.

## The Basking Sharks.

**Cetorhinus maximus** (Gunner).

## Basking Shark.

Body fusiform, elongated towards tail. Caudal peduncle keeled. Head small. Snout short, obtuse, glabrous. Eye near margin of upper lip. Mouth very large. Jaws armed with teeth of different forms. Teeth generally curved and turned inwards towards throat, sides slightly edged, without any appearance of distinct and regular serratures. Some small rugosities are perceptible on edge only. Upper teeth subconic at anterior extrem-



Basking Shark. *Cetorhinus maximus* (Gunner).

ity and at angle of mouth, both of which are smaller by  $\frac{1}{3}$  than those which occupy intermediate space and have but a single point to each, which in the greatest number is flattened and truncated. At angle of mouth 4 or 5 last rows flattened, subtriangular, and reclining upon each other. Intermediate teeth larger, subtriangular, one or two grooves on external face indicating union of points of which they appear composed. Of these points two are united, other often detached, very distinct and presenting a bifid appearance. Some teeth exhibit 3 points but rarely. Mandibular teeth rather larger than upper. Towards anterior extremity near angle of jaw a little elongated and lanceolate, and less conic but somewhat more compressed. Anterior extremity sensibly emarginate. These teeth not implanted deeply in skin, disposed in 7 or 8 distinct rows in middle, and younger ones on inner row. Nostrils placed before eyes beneath rostrum. Branchial apertures 5 on each side, anterior largest, extending from neck above to under part of chest, where they appear confluent with those of opposite side. Posterior gill-openings smallest. Spiracle very small, placed above and a little behind angle of jaw, and each corresponding with a long interior opening in mouth between upper jaw and first branchial opening. Skin rough to touch, particularly on passing hand forward, as it is covered with numerous small horny somewhat curved points. These small points assembled in groups to form numerous undulated abbreviated bands, united at their extremities and again dividing. Their breadth, on middle of body about two lines, and giving whole surface appearance of being wrinkled. These bands or wrinkles transverse on whole body from gill-openings to posterior end of caudal carina, where they disappear. On head, throat and behind spiracle they are longitudinal, upon branchial lamina and above pectoral they become oblique, and on latter their direction complies with movement of articulation of fins. All fins destitute of wrinkles. First dorsal triangular, a little emarginated, extended to a point, detached posteriorly and placed equidistant. Second dorsal very small, subtriangular, with posterior lobe detached at tip, and placed before anal. Anal subtriangular, with detached pointed lobe behind. Caudal large, straight, elevated, falciform. Lower lobe short and wide. Pec-

toral large, immediately behind fifth gill-opening, inferior, reaching a little beyond origin of first dorsal, strong anteriorly, flexible posteriorly. Ventral subtriangular, nearly intermediate between dorsals, anteriorly flexible. Claspers large, subcylindric, profoundly striated, above with striæ transverse and very rugose, medianly oblique and distally longitudinally, and also rugose. Lead-color, darker on back and paler on belly. Length 32 feet 10 inches, of dried skin 22 feet. Brown's Point. (Le Sueur.)

This very rare giant shark, which is apparently unknown to most fishermen, does not seem to have been noted since Le Sueur's time, early in the last century. At times large examples from other places outside the state are exhibited by traveling showmen.

*Cetorhinus maximus* Abbott, Geol. N. J., 1868, p. 828.

*Squalus clephas* Le Sueur, Journ. Acad. Nat. Sci. Phila., II, 1822, p. 343, Pl.

### Family GALEIDÆ.

#### The Typical Sharks.

Snout produced as usual among sharks, not hammer-shaped. Spiracles small or obsolete. Gill-openings moderate, last above base of pectoral. Oviparous. Dorsal fins 2, first short and high and entirely before ventrals. Second dorsal opposite anal, and comparatively small. Tail more or less bent upward from base of caudal fin, and sides without keel. Fins without spines.

This the largest group of recent sharks, found in all seas, has many species, often closely related and difficult to determine.

#### Key to the genera.

- a. MUSTELINÆ. Teeth flat and paved. CYNAINA
- aa. GALEINÆ. Teeth more or less compressed, with entire or serrate sharp edges.
  - b. Spiracles present; teeth all coarsely serrate, alike in both jaws, and all with deep notch on outer margin; caudal with double notch and without conspicuous pit above at root. GALEUS
  - bb. Spiracles obsolete; lower teeth narrower than upper.
    - c. Angle of mouth without groove, or with merely a slight depression not extending along either jaw. CARCHARINUS
    - cc. Angle of mouth with more or less distinct groove extending along one or both jaws; teeth nearly entire. SCOLIODON

## Genus CYN AIS Gill.

## The Dog Sharks.

*Cynais canis* (Mitchill).

## Dog Shark. Dog Sherk. Dog Fish.

Body long, slender, tapering from dorsal fin back. Caudal peduncle a little over half upper caudal lobe. Head rather broad, and snout with rounded profile when viewed from above, also depressed and sharp. Eye elongate, mouth crescent-shaped, small, and with well-developed labial folds. Teeth small, pavement-like, many-rowed, flat and smooth, and alike in both jaws. Spiracle small, just behind eye. Embryo without placenta. First dorsal large, close behind pectorals. Second dorsal smaller, though larger than anal. Anal behind front of second dorsal. Caudal a little less than  $4\frac{1}{2}$  in rest of body, and its terminal lobe about  $\frac{2}{5}$  its length. Lower caudal lobe obtuse. Pectoral large, obtuse, reaching first third of dorsal. Ventral about half size of pectoral. Color nearly uniform pale gray, whiter beneath. Length 17 inches. Great Egg Harbor Bay.

It is said to reach a length of 3 feet and also to sometimes be marked with pale spots. Very abundant during warm weather in the inlets and along the marshes. It is also abundant in the bay at Cape May, according to Mr. H. Walker Hand. Like other sharks this one bites well on fish-bait. They also appear to travel with the red drum, *Scienops ocellatus*. Many examples were examined from the lower Great Egg Harbor River, which it is said not to enter beyond the purely brackish region of tide-water. Atlantic City, Avalon, Stone Harbor, Anglesea and Cape May. Mr. I. N. DeHaven and myself caught many of these fish in the inlet back of Atlantic City one summer, and most all those examined had been feeding on crustacea. They took fish-bait readily.

*Mustelus canis* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 337 [353].—Abbott, Geol. N. J., 1868, p. 828.—Bean, Bull. U. S. F. Com., VII, 1887, p. 152.

*Calceus canis* Moore, Bull. U. S. F. Com., XII, 1892, p. 358.



## Genus GALEUS Walbaum.

## The Tiger Sharks.

**Galeus tigrinus** (Müller and Henle).

Spotted Shark. Leopard Shark.

Reaching a length of 30 feet, this large shark may be distinguished by its variegated coloration, which has earned for it the above vernaculars. It is apparently rare, and the small variegated sharks reported off our coasts at times and about Delaware Bay may really be this species, though as yet I have seen no specimens. They are said to be very tenacious and soon become of offensive odor after death.

## Genus CARCHARHINUS Blainville.

## The Requeim Sharks.

*Key to the species.*

- a.* Pectoral long and falcate, three times as long as broad.  
*au.* Pectoral shorter, twice as long as broad.

OBSCURUS  
MILBERTI

**Carcharhinus obscurus** (Le Sueur).

Santiago. Dusky Shark. Shark. Man Eater. Man Eating Shark.

Distinguished from the other sharks of the present genus chiefly by the very long falcate pectorals, which are 3 times as long as broad and reach beyond first dorsal. The upper teeth are oblique and deeply notched on their outer margins. Reaches a length of 10 feet.

During the summer of 1904 a large example belonging to this species was exhibited in the market at Philadelphia. It was taken about 10 miles off Cape Henlopen, Delaware. Others

were reported from the same localities by various fishermen, but none so large as this, which measured about 12 feet. They were called "santiagos" or "santiago," the impression prevalent among the fishermen being that the cannonading during the Spanish-American War had forced them to retreat to more quiet surroundings. The large example referred to was a male with well-developed claspers, and was brown above and dirty-white below when fresh. The lower surfaces of the fins were whitish like the belly, and their upper surfaces dark like the back. Teeth white and the iris slaty. Mr. H. Walker Hand reports that large sharks are common in shoal water during warm weather about Cape May. They may be seen swimming about with the high dorsal fin well exposed and hunting for soft-shell crabs. Though I have no definite information concerning their breeding, possibly the larger ones may be there for the purpose of copulating like their relatives are known to do. They also occur in the Delaware Bay about Cape May occasionally.

*Squalus obscurus* Abbott, Geol. N. J., 1868, p. 828.

*Carcharias obscurus* Bean, Bull., U. S. F. Com., VII, 1887, p. 152.

*Carcharhinus obscurus* Moore, Bull. U. S. F. Com., XII, 1892, p. 358.

***Carcharhinus milberti* (Müller and Henle).**

#### Small Blue Shark. White Shark.

Head 5; depth  $5\frac{1}{2}$ ; snout  $2\frac{1}{6}$  in head; width of mouth  $2\frac{1}{4}$ ; interorbital space  $1\frac{1}{5}$ ; front edge of first dorsal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; length of caudal peduncle  $2\frac{3}{5}$ ; upper caudal lobe  $3\frac{3}{4}$  in rest of body. Body strongly compressed, deepest at origin of pectoral. A pit at root of caudal above and below. Head broad, depressed, and profile of snout rather rounded as viewed from above. Eye circular, midway in head. Mouth broadly crescent-shaped, with a short fold only at each corner. Upper teeth less serrated, not notched on outer margin. Lower teeth erect and narrower, with fine serrations. Internasal space but little less than snout when measured from front of upper jaw. First dorsal

close behind pectoral, and its height  $1\frac{1}{2}$  in its length. Second dorsal's base about  $5\frac{3}{4}$  in interdorsal space. Lower caudal lobe  $2\frac{1}{2}$  in length of upper. Pectoral short, its tip not reaching as far as posterior edge of dorsal, and greatest width of fin  $1\frac{4}{5}$  in its length. Origin of ventral a little nearer posterior basal edge of first dorsal than origin of second dorsal. Color grayish, paler below. Iris whitish. Length  $23\frac{3}{4}$  inches. Great Egg Harbor Bay.

The small sharks found abundantly about the inlets of Atlantic City, Anglesea and Cape May seem to belong to the present species. My example agrees fairly well with the figure given by Müller and Henle. It does not seem likely that they are entirely all referable to the dusky shark, a species known at once by its long falcate pectorals. Those which I observed were frequently caught with dog fish. Mr. Wm. J. Fox reports sharks from Sea Isle City which are apparently this species.

*Carcharias cæruleus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 352.

*Squalus cæruleus* Abbott, Geol. N. J., 1858, p. 828.

## Genus SCOLIODON Müller and Henle.

### The Sharp Nosed Sharks.

*Scoliodon terræ-novæ* (Richardson).

### Sharp Nosed Shark.

Head  $5\frac{1}{4}$ ; depth 7; snout  $2\frac{1}{3}$  in head; width of mouth  $2\frac{7}{8}$ ; interorbital space  $2\frac{1}{3}$ ; front edge of first dorsal  $1\frac{3}{4}$ ; pectoral  $1\frac{1}{7}$ ; length of caudal peduncle  $2\frac{2}{3}$ ; upper caudal lobe  $2\frac{2}{3}$  in rest of body. Body slender. Head depressed. Snout depressed, a little long, and rounded when viewed from above. Eye circular, a trifle anterior. Mouth with rather deep gape, and a short labial groove at its angle on both upper and lower jaws, though former longer. Teeth entire, oblique, flat and points directed towards sides of mouth so that inner margins are more or less horizontal. Teeth not swollen at base, and each with a deep

notch on outer margin below sharp point. Internasal space greater than nostrils are from tip of snout. First dorsal midway between pectoral and ventral, of moderate size. Second dorsal very small. Anal a little larger and inserted a little in advance. Caudal long, slender, and lower lobe  $2\frac{4}{5}$  in upper lobe. A pit at root of caudal above and below. Pectoral short, reaching about opposite middle of first dorsal, and greatest width  $1\frac{2}{3}$  in length. Ventral small, inserted about first third of interdorsal space. Color gray, paler below. Iris pale. Margin of caudal dusky in spirits. Length nearly 26 inches. Holly Beach.

This small shark is only known to me from the New Jersey coast by the above example in the Academy of Natural Sciences of Philadelphia.

### Family CESTRACIONTIDÆ.

#### The Hammer Head Sharks.

Mouth crescent-shaped, under "hammer." Teeth in jaws similar, oblique, each with notch on outside near base. Nostrils anterior and eyes on sides of "hammer." Last gill-opening over pectoral. No spiracles. First dorsal and pectorals large, and dorsals nearer pectorals than ventrals. Second dorsal and anal small. Pit at root of caudal, and notch single towards tip of fin.

Large sharks, known at once by the singular form of the head, which is not quite the same in any two species. A single genus with 2 species on our coast.

#### Genus CESTRACION Walbaum.

#### The Hammer Head Sharks.

#### *Key to the species.*

a. Head kidney-shaped; nostril with frontal groove short or obsolete.

aa. Head hammer-shaped; nostril with well-developed groove extending along front of head.

TIBURO  
ZYGÆNA

***Cestracion tiburo* (Linnæus).**

## Bonnet Headed Shark.

A small shark about 5 feet in length of uniform ashy color with some resemblance to the hammer head, but easily to be distinguished by the kidney-shaped head.

I have not seen any New Jersey examples. Possibly the reports of the "shovel nose shark" from Cape May may in part refer to this species. It is also possible that the fisherman may apply the same name to species of *Carcharhinus*. Ashmead obtained it at Beesley's Point, where it was also reported to Baird.

*Zygæna tiburo* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 337 [353].

*Cestracion tiburo* Abbott, Geol. N. J., 1868, p. 829, from Baird.

*Reniceps tiburo* Bean, Bull. U. S. F. Com., VII, 1887, p. 152, from Baird.

***Cestracion zygæna* (Linnæus).**

Hammer Head Shark. Hammer Head. Hammer Heap Shark.  
Shovel Nose Shark.

Head  $5\frac{1}{2}$ ; depth about 9; width of head  $3\frac{3}{5}$ ; width of mouth  $2\frac{5}{6}$  in head; front edge of first dorsal  $1\frac{1}{5}$ ; pectoral  $1\frac{3}{5}$ ; length of caudal peduncle  $2\frac{3}{7}$ ; upper caudal lobe  $2\frac{1}{5}$  in rest of body. Body rather slender, not much compressed. Head truly hammer-shaped, and length of hammer along posterior margin nearly equal to its width near eye. Eye a little elongate. Mouth with rather deep gape. Teeth entire, similar in both jaws and with notch at base on outer edge. First dorsal large, falcate, and close behind pectorals. Second dorsal smaller than anal, which begins a little in advance. Caudal long, and lower lobe  $2\frac{1}{2}$  in length of upper. Pectoral rather short, greatest width  $1\frac{2}{3}$  in its length, and not quite reaching end of base of dorsal. Ventral broad, and inserted a little before middle of interdorsal space. Color when fresh slaty, a little paler below. Edges of caudal,

dorsal and pectorals tinged blackish. Iris blue-black. Length nearly 21 inches. Grassy Sound.

I have taken this species associated with *Cynais canis* and *Carcharhinus milberti* in the inlets and waters on the flats below Atlantic City. South of this region it is abundant, many examples having been secured at Stone Harbor, Anglesea, Holly Beach and Cape May. Mr. Wm. J. Fox found it frequently off Sea Isle City running to 3 feet in length. At times it is especially abundant and a great annoyance to fishermen. Off shore they reach a large size, some said to be 15 feet in length. In the inlets they are usually less than a yard, while the large ones outside often attain 9 feet. According to Mr. H. Walker Hand they were reported as usually irregular, probably traveling in schools and taking fish-bait. He also states that they are abundant at times in Delaware Bay. Dr. Dahlgren reports it from a number of places along our coast.

*Sphyrna zygaena* Bean, Bull. U. S. F. Com., VII, 1887, p. 151.

*Zygæna malleus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 337 [353].

*Cestracion subarcuatus* Abbott, Geol. N. J., 1868, p. 828.

### Family SQUALIDÆ.

#### The Dog Sharks.

Body more or less elongate. Head depressed. Eyes lateral, without nictitating membrane. Mouth inferior, rather large, arched, and deep groove on each side. Teeth compressed, variously formed. Nostrils inferior, separate. Gill-openings moderate, all in front of pectorals. Spiracles rather large. Oviparous. Dorsal fins 2, and first in front of ventrals. Caudal with lower lobe small or obsolete. Ventrals inserted posteriorly, not much before second dorsal.

Small sharks, chiefly of the Atlantic, representing a comparatively primitive type. A single genus and species from our shores.

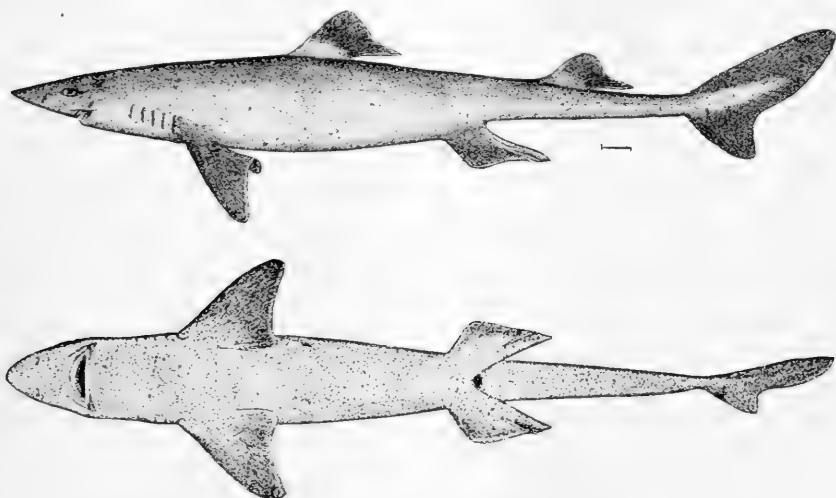
Genus *SQUALUS* Linnæus.

The Spiny Dog Sharks.

*Squalus acanthias* Linnæus.

Spiny Dog Fish. Cod Shark. Cod Fish Shark. Thorn Back Shark.

Head  $5\frac{2}{3}$ ; depth about  $7\frac{1}{2}$ ; snout  $2\frac{2}{3}$  in head; width of mouth 3; interorbital space  $2\frac{2}{3}$ ; front edge of pectoral  $1\frac{1}{5}$ ;



Spiny Dog Shark. *Squalus acanthias* Linnæus.

length of caudal peduncle  $1\frac{3}{5}$ ; upper caudal lobe  $4\frac{1}{4}$  in rest of body. Body long and slender. A pit at root of caudal above. Head depressed, elongately triangular when viewed above. Eye elongate, a trifle anterior. Mouth little curved. Teeth simple. Nostrils midway in snout below. Internasal space a little less than space between tip of snout and nostrils. First dorsal midway between pectoral and ventral. Second dorsal smaller, nearer caudal than first dorsal. Caudal with lower lobe rounded, half length of upper. Pectoral small, not reaching first dorsal, and greatest width a trifle more than half its length. Ventral blunt.

a little nearer second dorsal than first. Dorsal spines at least two-fifths height of fin, posterior higher. Slaty-gray above, paler below. Length of a male 31 inches. Cape May.

Color in life of the above described individual was mouse-gray slightly glistening with dull heliotrope-purple reflections, especially on each myomere above. Back also marked sparsely with an irregular series of small whitish spots on each side. Several dull dusky or blackish spots, some nearly as large as pupil, on back. One on nape and caudal peduncle largest and most distinct. Dorsals and caudal a little more grayish than back, also a little paler. Pectorals colored like back above, also with several dusky spots, but below a dirty sandy-white like lower surface of body. Ventrals like lower surface, though only slightly darker above. Lower surface of caudal peduncle white like that of abdomen. Iris beautiful silvery shading into deep slaty above and below, and also with iridescent reflections. Peritoneum white.

An abundant winter visitant about Cape May and not yet observed in Delaware Bay. They generally arrive at Cape May late in October or early in November. Sometimes more are taken on set-lines with fish-bait than cod, which they follow. Most examples run about 30 inches in length. They were very abundant at Sea Isle City during the winter of 1904-5. Those taken early in the fall were all males, the females apparently coming later. Dr. Dahlgren reports it from off Asbury Park.

*Squalus acanthias* Bean, Bull. Am. Mus. N. H., IX, 1897, p. 330.

*Squalus americanus* Abbott, Geol. N. J., 1868, p. 829.

### Family PRISTIDÆ.

#### The Saw Fishes.

Body elongate, depressed. No nictitating membrane. Teeth in jaws minute, obtuse. Nostrils inferior, no tentacles. Dorsals large, first nearly opposite ventrals. Caudal well developed, bent upward, and a fold of skin along each side of tail. Pectorals moderate, front margin quite free, not extending to head.

Found in warm seas on sandy shores and sometimes ascending rivers. A single genus and species on our coast.



## Genus PRISTIS Linck.

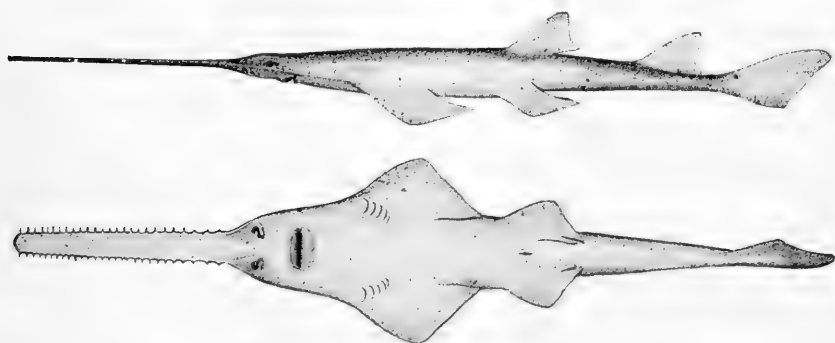
## The Saw Fishes.

**Pristis pectinatus** Latham.

## Saw Fish.

Easily identified from any of our fishes by the very long produced saw-like snout. This saw is said to have from 24 to 32 pairs of teeth. Large examples reach a length of 20 feet.

Some years ago 2 were taken in the ocean off Cape May, the last of which was a little less than 15 feet in length. It was captured in a seine while fishing for weak fish, *Cynoscion*,



Saw Fish. *Pristis pectinatus* Latham.

goodies, *Leiostomus*, etc., and afterwards mounted and placed on the pier for exhibition. Mr. Witmer Stone tells me of one taken in August of 1900, probably one of the above. Two remoras were found attached. So far as I can learn the only other record is that of an example from Grassy Sound. It has never been seen in Delaware Bay.

*Pristis* sp. Shields, Am. Nat., XIII, 1879, p. 262.

## Family RAJIDÆ.

## The Skates.

Disk broad, rhombic. Oviparous. Eggs laid in large leathern cases, 4-angled, with 2 long tubular horns at each end. No

electric organs. Skin more or less roughened with spines or prickles. Sometimes a caudal on tail, which is stout, rather long and with longitudinal fold on each side. Pectoral fins extend to snout. Ventrals large.

In all cool seas, some species in deep water. A single genus with several species in our waters.

### Genus RAJA Linnæus.

#### The Skates.

#### *Key to the species.*

- a. Middle line of back and tail unarmed in adult, with a row of spines in young; outline of disk before spiracles obtuse, without acute angle at tip of snout.
  - b. Teeth about  $50/50$ ; small. ERINACEA
  - bb. Teeth about  $90/90$ ; large. OCELLATA
- aa. Middle line of back with a row of spines at all ages.
  - c. Teeth about  $40/40$ ; tip of snout acute. EGLANTERIA
  - cc. Teeth about  $30/30$ ; tip of snout much produced. LEVIS

#### **Raja erinacea** Mitchill.

#### PLATE 2.

#### Hedge Hog Ray.

Body semi-diaphanous so that skeleton can be seen when held against light, especially snout and margins of pectorals. Head rounded. Snout a little pointed. Cheeks parting projections of curved form on sides of snout laterally anterior to eyes. Eyes half covered and elegantly curtained. Teeth in both jaws, associated, compact and sharp-pointed. Nostrils distinct, and connected with mouth through fissures to upper lip. Skin slimy, scaleless, beset with prickles in spots or patches. A patch in front of each eye reaching along inner orbit and occupying space between eyes. Two lines of spines from each ocular patch to tip of snout where they join with the form of an inverted V. Cheeks covered with prickles. Behind eyes on top of head an equilateral triangular patch of prickles with one of its sides back

and angle forward. On each pectoral a patch of catspaw retractile prickles. Along edges of nasal flaps minute prickles for a short distance. Along each side of back a row of stiff short spines proceeding towards tail, smaller ones near them with rather irregular distribution. On tail more numerous distinct and strong, and distinguishable in 2 main rows with a smooth area between reaching to dorsals. Lower side of tail and whole belly quite smooth. Each clasper with a slight rough patch. Tail thick and stout, and 9 inches from base of ventrals. At its tip 2 faintly radiated fins jagged behind with several slits or notches, and posterior entire. Trace of a third fin near very end of tail in form of a neat film. Pectorals rounded. Ventrals each with 3 little protuberances backward. Claspers about 5 inches long. Length 17 inches, width  $9\frac{1}{2}$  inches. (Mitchill.)

Mr. Wm. J. Fox obtained it at Sea Isle City, and it does not seem to have been noted otherwise since Mitchill's original account, when it was taken at Barnegat and on the fishing banks southeast of Sandy Hook. Mr. Fox reports that nearly 25 were taken in late April of 1906. They varied but little in color. It may occur even about Cape May as the reports of certain small skates from there agree fairly well.

*Raja erinaceus* Mitchill, Am. Journ. Sci. Arts, IX, 1825, p. 290, Pl. 6 (2 figs.).—Abbott, Geol. N. J., 1868, p. 829, from Mitchill.

**Raja ocellata (Mitchill).**

PLATE 3.

Big Spotted Skate.

This is distinguished from the preceding chiefly by its more numerous teeth, and usually a large white ocellus on each pectoral.

This species is included on the authority of Prof. Ulric Dahlgren who tells me of 2 examples taken in the traps during the fall of 1904 at Asbury Park. These are the only examples known from the New Jersey coast, and I am indebted to Prof. Dahlgren for their determination. The species reaches a very large size, nearly 3 feet.

*Raja eglanteria* Lacépède.

Skate. Brier Ray. Possum Ray. Sea Possum. Bob Tailed Skate.

Length of disk, from tip of snout to base of tail, less than greatest width; interorbital space  $2\frac{1}{2}$  in snout measured to eye; width of mouth 2; eye 2 in interorbital space; tail a little less than body measured from tip of snout to its own base. Anterior margins of disk when viewed above at first a little convex, and greatest width of disk falling about last  $\frac{2}{3}$  of its length. Eyes elongate. Mouth a little curved, with more than 40 rows of teeth in each jaw. Above with minute pricks and along middle of anterior margin of disk a patch of enlarged ones. Median line of snout and interorbital space with minute asperities. A median line of thorns from just behind interorbital space, which is shallowly concave, to dorsal fins. A spine between dorsals. On each side of tail a series of similar thorns with irregular thorns of smaller size above and between them and median series. Body below smooth, except anterior margins of disk and lower surface of snout, which are finely asperous. A thorn at each shoulder. Dorsals 2, near end of tail, close together, and posterior a little larger. Anterior margin of pectoral nearly straight, posterior edge a little convex. Ventral with anterior lobe a little prolonged. Color pale brown on upper surface marked with many bars, blotches, spots and lines medianly. A translucent space on each side of snout. Below whitish. A male about 20 inches long. Atlantic City. A little larger female I collected at Anglesea was altogether more asperous with very distinct markings on the upper surface.

Abundant, often especially so during summer. I have seen many examples from Barnegat, Atlantic City, Sea Isle City, Stone Harbor, Grassy Sound, Anglesea and Cape May. In the latter place many are taken with sting rays, *Dasybatus*, in the pounds built for king crabs and weak fish. It is also sometimes noticeably abundant there during the fall and occurs in Delaware Bay. Though I have no information of the breeding of this species on our coast Mr. H. Walker Hand saw a pair in coitus off the

Virginia coast in the spring of 1901. They were harpooned in about 3 feet of water. The male had mounted the female from above in a somewhat diagonal manner, evidently grasping the upper part of the left pectoral fin anteriorly in his teeth. The tail was directed towards the right side with both claspers forward and well inserted. Doubtless the same obtains on our shores. Easily known by its pointed snout, median series of thorns on back beginning close behind eyes, and numerous series of teeth in the jaws which are always 40 or more. According to Mr. J. A. G. Rehn it is the most abundant skate at Atlantic City.

Drs. Jordan and Evermann place *Raia chantenay* Le Sueur as identical with this species, a precedent which I am unable to accept. That it is identical with the following species, *Raja lævis* Mitchill, I do not doubt, for the following reasons. The median series of thorns on the upper surface of the body are only on the upper surface of the tail, not beginning on the back close behind the eyes, and according to Le Sueur's figure the teeth are in but 30 series at most. Further the same writers state that the type locality is Delaware Bay, but Le Sueur does not give any definite locality only stating that his description is from an example contained in the Philadelphia Museum. Le Sueur's account of *Raia eglanteria* seems, however, to agree with this species. Dr. Abbott's references to *Raia americana* = *Raja radiata* (Donovan) does not leave it clear that that species has ever been taken in the state.

*Raja eglanteria* Bean, Bull. U. S. F. Com., VII, 1887, p. 151. —Moore, Bull. U. S. F. Com., XII, 1892, p. 358.—Smith, Bull. U. S. F. Com., XII, 1892, p. 368.

*Raia diaphanes* Abbott, Geol. N. J., 1868, p. 829.

***Raja lævis* Mitchill.**

PLATE 4.

Skate. Barn-Door Skate.

Body flat, subrhomboidal, about  $\frac{1}{5}$  broader than long. Head but little elevated. Rostrum projecting, acute, of moderate size,

rough at tip and furnished with very small points. Eye small, not prominent. Mouth transverse, rectilinear, armed with small flat pentagonal teeth, a little separated in each jaw. Nostrils small and canal communicating with mouth covered by a large rounded appendice with fringed margin. Branchial apertures 5 on each side, subequal, subequidistant, and placed upon an oblique line. Spiracles large, very near and behind eyes. Body above glabrous, excepting on anterior pectoral margins, between eyes, and on extremity of rostrum, which are rough to touch. Tail very robust, margined with a slight membrane on each side, sub-depressed, armed laterally with points, terminated by 3 rounded fins, of which third is very small near tip of tail and others subequal and larger. Pectoral large, triangular, terminating obtusely on sides, narrow and rounded behind. Ventral emarginate, wide before, narrow behind. Vent posterior to origin of ventral. Color with scattered reddish-brown spots of various sizes and forms, and a transversely oblong subocellated spot each side of middle. Below whitish, lightly tinted with rosaceous, and surface smooth. Towards anterior part of each side of vent 6 small black lines or spots. Ventral radii very distinct below. Iris yellow. Length to base of tail 2 feet, width  $2\frac{1}{2}$  feet, and tail as long as space intervening between eyes and its base. From a dried specimen in the Philadelphia Museum.

The male has teeth discoidal at base, surmounted by a short point directed towards throat, and less abraded than those of female in which they are more flattened and pentagonal. Rostrum furnished above with points extending nearly to extremity of fin, long, strong, inflected towards middle of back, quincunx, and of 4 approximate rows. Orbits with small points before and behind, rendering these parts rough to touch, but not so distinct as those opposite eyes, otherwise skin is smooth. Tail depressed, wide at base, armed on each side with row of spines and with membrane beneath spines. Reddish above, beneath whitish, sprinkled as above with small blackish spots. Size in agreement with female.

(Le Sueur.)

This species occurs at times along various points of the southern shore but in my experience is less abundant than the former. It has been noted at Sea Isle City, Atlantic City, Stone

Harbor and Cape May. It may be taken frequently, however, when young and confused with the former. It is easily recognized by the long snout, smooth back without median series of thorns beginning till tail, fewer teeth and as the largest of our skates, sometimes reaching a length of 5 feet. Dr. Abbott records an example taken in the Delaware, in 1860, where, however, it was only a straggler, as it never wanders much out of salt water.

*Raia lævis* Abbott, Geol. N. J., 1868, p. 829.—Bean, Bull. U. S. F. Com., XII, 1892, p. 358.—Smith, Bull. U. S. F. Com., XII, 1892, p. 368.

*Raia chantenay* LeSueur, Journ. Acad. Nat. Sci. Phila., IV, 1824, p. 106, Pl. 5, figs. 1–8.

### Family DASYBATIDÆ.

#### The Sting Rays.

Disk usually more or less broader than long. Mouth rather small. Teeth small, paved, usually more or less pointed or tubercular. Nostrils close together. Nasal valves forming a rectangular flap joined to upper jaw by a narrow frenum. Skull not elevated, eyes and spiracles superior. Spiracles large, placed close behind eyes. Species ovoviviparous. Skin smooth, variously prickly or spinous, roughest in adult. No differentiated spines on pectorals in males, sexes similar. Tail various, usually whip-like, sometimes short and stout, sometimes bearing a single dorsal or caudal fin, never 2 dorsals. Usually 1 or more vertical folds of skin on tail, rarely a lateral fold. Ventrals not emarginate.

Found in most warm seas, some in fresh waters of South America. The large jagged spine on the muscular tail is capable of inflicting a severe and even dangerous wound.

#### Key to the genera.

- |   |           |
|---|-----------|
| a. Tail stout, with rayed caudal fin.   | UROLOPHUS |
| aa. Tail slender, without caudal fin, whip-like and longer than rounded disk. | DASYBATUS |

Genus *UROLOPHUS* Müller and Henle.

The Round Sting Rays.

*Urolophus jamaicensis* (Cuvier).

Membranous flap from above upper posterior portion of orbit forms broad cover for spiracle, quite as large as spiracle, rounded above and produced in an acute angle extending behind opening. Spiracular opening an elongate slot, and valve well developed. Very light olivaceous freckled with brown. Posterior half of tail obscurely ringed with brown and lighter color. Length 5 inches. New Jersey. (Garman.)

Known from our coast by the above described foetus, No. 8,184, United States National Museum.

*Urolophus torpedinus* Garman, Proc. U. S. Nat. Mus., VIII, 1885, p. 41.

Genus *DASYBATUS* Walbaum.

The Sting Rays.

*Key to the species.*

- a. Tail with wing-like expansion below only; adult with stout bucklers on back and tail; tail rough, more than twice length of disk. CENTROURA
- aa. Tail with narrow keel or expansion both above and below.
  - b. Tail with wing-like expansion below, simply keeled above; 3 series of tubercles on shoulder. HASTATA
  - bb. Tail with wing-like expansion above and below, latter larger; skin nearly or quite smooth in adult. SAY

*Dasybatus centroura* (Mitchill).

Stingaree. Sting Ray. Devil Fish. Pigeon Sting Ray.

Distinguished from all our other species by the presence of a keel or wing-like expansion on the lower surface of the tail only.

This is the common species about Cape May. Some stings are



5 inches in length, and examples have been taken which measured 5 feet across the disk. They were usually most plentiful in the bay and were formerly used to some extent as fertilizers. Mr. Wm. J. Fox found it at Sea Isle City.

*Dasyatis centrurus* Moore, Bull. U. S. F. Com., XII, 1892, p. 358.—Smith, Bull. U. S. F. Com., XII, 1892, p. 368.

***Dasybatus hastata* (DeKay).**

Whip Sting Ray.

From the next species this one may be known by the more prickly back of adult or old examples. A row of narrow compressed tubercles along middle of back on to base of tail with depressed and posteriorly directed points.

I have never seen any New Jersey examples.

*Pastinaca hastata* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 337 [353].

*Trygon hastata* Bean, Bull. U. S. F. Com., VII, 1887, p. 151.

*Trygon sayii* Abbott, Geol. N. J., 1868, p. 829, from Baird.

***Dasybatus say* (Le Sueur).**

Say's Sting Ray.

Body suborbicular, above convex, beneath flat, and broader a short distance behind eyes. Head sloping, and length from base to middle of nose nearly equal to distance between eyes. Tip of snout truncated, quadrangular, descending, and closing mouth. Eyes oblique, not prominent. Mouth small. Upper jaw undulated, and lower a little prominent in middle. Teeth dilated, rhomboidal at base, terminated by an acute point, recurved inwards, with longitudinal depression before, and in several rows. Lateral teeth more suddenly attenuated. Attached to upper jaw within is a large membrane, laciniated and loose at margin. Attached to lower jaw within are five conic membranous appendages supporting superior membrane during its inflation. A longitudinal carinated loose skin separates palate in two equal

parts. Nostrils small, nearer angle of mouth than middle of nose. Gill-openings obliquely behind angles of mouth, unequal, and posterior much smaller. Body smooth. Two elongated vertical fins opposite on tail behind spine. Tail a little longer than body, thicker and subcompressed at base, attenuated, and at point acute. Spine placed nearer base than tip of tail. Fins on tail thick, smooth and without distinct rays, elevated in middle and gradually sloping towards extremities. Superior fin of tail shorter than inferior, arising from near tip of spine, and inferior arising near base of spine. Ventral fins rounded, with small process near tail. Color olivaceous-red, darker near extremity of fins, on upper surface. Lower surface white. Eye brown. Fins on tail black. Largest example 18 inches long without tail, 16 to 17 inches wide, and 4 to 5 inches thick. Bay shore of Egg Harbor. (Le Sueur.)

This does not seem to have been found since Le Sueur's time.

*Raja* say Le Sueur, Journ. Acad. Nat. Sci. Phila., 1817, p. 42.

### Family MYLIOBATIDÆ.

#### The Eagle Rays.

Disk broad. Nasal valves forming rectangular flap with posterior margin free and attached by frenum to upper jaw. Oviviparous. Skull less depressed than usual among rays, its surface raised so that eyes and spiracles are lateral in position. Skin smooth. Tail very long, slender, whip-like, with single dorsal near its root, behind which is usually a strong retrorsely serrated spine. Pectorals ceasing on sides of head and reappearing in front of snout as 1 or 2 cephalic fins supported by fin rays. No differentiated spines on pectorals in males, sexes similar. Ventrals not emarginate.

Large sting rays in warm seas, feeding chiefly on mollusks, which they crush with their large grinding teeth.

#### *Key to the genera.*

- a. Muzzle entire.
- aa. Muzzle emarginate; cephalic fins below level of disk.

MYLIOBATIS  
RHINOPTERA

## Genus MYLIOBATIS Duméril.

## The Eagle Rays.

*Myliobatis freminvillii* Le Sueur.

## Stingaree.

This may be known from the next species by the entire muzzle.

This is only known positively from our coast by the record of Dr. Bean from an example from near Longport.

*Myliobatis freminvillii* Bean, Bull. U. S. F. Com., VII, 1887, p. 151.

## Genus RHINOPTERA Kuhl.

## The Cow Nosed Rays.

*Rhinoptera bonasus* (Mitchill).

## Cow Fish. Cow Nosed Ray.

Body rhomboidal, gibbous on middle of back. Below flat. Head distinct, sloping, grooved longitudinally above, and neck with several protruberances. Inferior lobes of middle of nose rather longer than others, superior ones obtuse and roundish. Eyes lateral, vertical, equidistant from spiracles and tip of superior lobes, and pupil very small. Mouth wide, with several rows of flat wide teeth of different dimensions, central ones largest, and lateral ones diminishing towards angles of mouth, those of each row but a moiety of preceding ones. Jaws applied to each other by a transverse obtuse elevation in middle. Nostrils equidistant from tip and middle of nose, which is flat, a little dilated, truncate, denticulated, covering superior jaw, and lateral fold continued a short distance below angles of jaw. Gill-openings oblique behind mouth, gradually decreasing in breadth to terminal one, which is small and more distant. Spiracle large. Tail attenuated, very slender, a little longer than body, and with a small triangular fin at base preceding serrated spine. Ventral narrow, a little elongated and obliquely truncated. Color above brown-

ish-olivaceous, below white. Pupil black, iris yellow. Length 16 inches, without tail, and width 2 feet. Egg Harbor.

(Le Sueur.)

I have no records, except an uncertain one for Stone Harbor, during October of 1897, since the one taken by Le Sueur for Egg Harbor. The Stone Harbor example was called "cow fish" by the fishermen, though it may not have been this species at all.

*Raia quadriloba* Le Sueur, Journ. Acad. Nat. Sci. Phila., I. 1817, p. 44.

*Rhinoptera quadriloba* Abbott, Geol. N. J., 1868, p. 828.

### Family MOBULIDÆ.

#### The Sea Devils.

Disk broader than long. Eyes lateral. Mouth wide, terminal or inferior. Teeth in many series, those in upper jaw sometimes wanting. Nostrils widely separated, valves united, and forming a flap as wide as mouth-cleft. Ovoviviparous. Skin more or less rough. Tail long and slender, whip-like, with single dorsal at base and with or without serrated spine. Pectoral fins not continued on side of head, anterior or cephalic portion separated and developed as 2 long horn-like or ear-like appendages. Ventral fins not emarginate. Sexes similar, males without differentiated spines on pectorals.

Enormous rays, among the largest of all fishes, in tropical seas, the species *Manta birostris* sometimes straying to our shores.

#### Genus MANTA Bancroft.

#### The Devil Fishes.

#### *Manta birostris* (Walbaum).

#### PLATE 5.

#### Devil Fish.

Eyes prominent, lateral, semiglobular, situated on a conical base at origin of cephalic flap and nearly on anterior part of head.

On each side of mouth a large flabelliform moveable flap. Mouth very large, horizontal and terminal. Jaws terminal, lower a little advanced, unequal and very small asperities in place of teeth. These teeth distant in many rows, though in upper jaw hardly perceptible. Nostrils small, placed beneath anterior angle of flap near angle of mouth, and each covered by a small rounded lobe. No apparent tongue. Gill-openings 5, large, linear, sustained by cartilage half their length, placed very near each other, and fifth smallest. Spiracles behind eyes, near widest superior margin. Skin without tubercles or spines but rough to touch. Tail longer than body, armed with 1 or 2 spines, subcompressed, feeble and soft, without asperities or spinous tubercles. Dorsal fin small, triangular and placed on base of tail between ventrals. Pectorals equal in length and width, arcuated before, lunate behind, and a little dilated and rounded at extremity near ventrals. Ventrals small, rounded, narrow, not longer than pectorals, and united with them. Vent small, longitudinal and between origin of ventrals. Color above blackish, a little tinged with reddish, somewhat clouded, and branchial rays marked and distinct by a darker tint which followed direction of interior cartilages in arcuated lines. Below white, dusky on posterior margin with many darker spots, irregular in form and disposition, largest on abdomen, and smaller on margin and middle of fins. Width 15 or 16 feet, length 7 feet 9 or 10 inches, tail 4 or 5 inches longer than body, mouth 2 feet 6 inches wide, eye 2 inches in diameter with pupil 9 lines, cephalic flap 2 feet  $2\frac{1}{2}$  inches long from eye by 1 foot wide. Taken near the entrance of Delaware Bay.

(Le Sueur.)

From this it will be seen that *Cephaloptera giorna* Le Sueur did not come from Georgia, as supposed by Drs. Jordan and Evermann.

Only known from our shores, aside from the accounts of Mitchill and Le Sueur, by the example taken about a mile off Stone Harbor which I reported in 1903. Mr. David McCadden, of Philadelphia, furnished the information concerning the identity of this specimen, and together with the eye I am able to positively determine the same. The note containing the record

for this species was shortly afterwards the subject of a somewhat uncalled for article by Dr. Theodore N. Gill, of Washington. With all the humiliation of defeat due to the several technical errors committed, it is trusted that full atonement has been made in their corrections, which were published soon after. For this reason I do not take this opportunity of thanking our venerable critic for the valuable suggestions to expunge the errors already referred to, as I had decided on their monstrosity before he had wasted so much of the printer's ink. A word further as to the entirely unnecessary detailed pedantry. Every writer acquainted with Walbaum knows the status of his work, and thus one may err occasionally in the definitions just as our critic has in some of his strange interpretations. Much is to be expected of the savant, even perfection itself, and when one is subjected to the censure of ridicule which may even approach dangerously near the opprobrious, well may he pause in the advocacy of such precepts.

*Manta birostris* Fowler, Proc. Acad. Nat. Sci., Phila., April, 1903, p. 332, a correction.

*Cephalopterus vampyrus* Mitchill, An. Lyc. Nat. Hist. N. Y., I, 1824, p. 23, Pl. 2, fig. 1.

*Ceratoptera vampyrus* Abbott, Geol. N. J., 1868, p. 829, compiled.

*Cephaloptera giorna* Le Sueur, Journ. Acad. Nat. Sci., Phila., IV, 1824, p. 115, Pl. 6, figs. 1-4.

*Manta manatia* Fowler, Science, XVII, April 10th, 1903, p. 595.

### Sub-Class ACTINOPTERI.

#### True Fishes.

Membrane bones of head, as opercle, preopercle, etc., developed. Skeleton usually bony, sometimes cartilaginous. Skull with sutures. Lungs imperfectly developed or degraded to form swim-vessel, or entirely absent. Heart developed, divided into an auricle, ventricle and arterial bulb. Gills with their outer edges free, their bases attached to bony arches, normally four pairs of

these, and fifth pair being typically modified into tooth-bearing lower pharyngeals. Ova small. Median and paired fins developed, latter with distinct rays. No claspers.

*Key to the orders.*

- a. (*Ganoidei*.) Arterial bulb muscular, with numerous valves; optic nerves forming a solid chiasma; air-vessel with well-developed duct; tail strongly heterocercal throughout life; some fins usually with fulcra; ventrals abdominal.
  - b. Skeleton cartilaginous; air-vessel simple; skin with bony shields; caudal forked. CHONDROSTEI
  - bb. Skeleton bony; air-vessel cellular; scales as rhombic enamelled plates; caudal rounded. RHOMBOGANOIDEA
- aa. (*Teleostei*.) Arterial bulb thin, with a pair of opposite valves; optic nerves crossing, not forming a solid chiasma.
  - c. Gill-openings before pectoral.
    - d. Air-vessel if present connected by an air-duct with intestinal canal and persistent through life; ventrals if present abdominal, without spines and basal segments rudimentary.
      - e. Head naked; dorsal inserted medianly or anteriorly.
        - f. Vertebrae not undifferentiated, anterior similar to others.
          - g. Body not eel-like; shoulder-girdle attached to skull by means of post-temporal; maxillary perfect, rarely wanting; precoracoid arch present. ISOSPONDYLI
          - gg. Body eel-like; shoulder-girdle not attached to skull; maxillary wanting or united with palatines; no precoracoid arch. APODES
        - ff. Anterior vertebrae modified, co-ossified, and with ossicula auditus.
          - h. Maxillary perfect, not entering into a barbel. EVENTOGNATHI
          - hh. Maxillary imperfect, forming base of long barbel. NEMATOGNATHI
      - ce. Head scaly; dorsal usually inserted far back; precoracoid obsolete; anterior vertebrae unmodified; parietal separated by supraoccipital. HAPLOMI
    - dd. Air-vessel without duct in adult; ventrals without basal segments; pectorals usually separated by supraoccipital.
      - i. Spines usually present in fins. ACANTHOPTERI
      - ii. No spines in fins. ANACANTHINI
  - cc. Gill-openings in axil or behind pectoral. PEDICULATI

**Order CHONDROSTEI.**

The Sturgeons.

Contains only the family of Sturgeons.

**Family ACIPENSERIDÆ.**

The Sturgeons.

Body elongate, subcylindrical. Snout produced, depressed and subspatulate. Eyes small. Mouth small, inferior, protractile, with thickened lips. No teeth. Maxillary distinct from premaxillaries. Four barbels in a transverse series on lower side of snout in front of mouth. Nostrils large, double, in front of eye. Gills four and an accessory opercular gill. Gill-membranes united to isthmus. No branchiostegals. Pseudobranchiæ small or obsolete. Air-vessel large, simple, connected with œsophagus. Stomach without blind sac. Pancreas divided into pyloric appendages. Rectum with a spiral valve. Body armed with five rows of bony bucklers, each with a median carina terminating in a spine which sometimes becomes obsolete with age. A median dorsal series and a lateral and abdominal series on each side, latter sometimes deciduous, and between these skin rough with small irregular plates. Head covered by bony plates joined by sutures. Fin rays slender, all articulated and vertical fins with fulcra. Dorsal placed posteriorly, anal somewhat behind it and similar. Tail heterocercal, lower caudal lobe developed and upper covered with rhomboid scales. Pectorals placed low. Ventrals many-rayed and behind middle of body.

Large fishes of the seas and fresh waters of northern countries, feeding on small animals and plants sucked in through the tube-like mouth. The variation due to age is great and together with the individual variation has given rise to many nominal forms. In our waters but two species referable to the genus *Acipenser*.



## Genus ACIPENSER Linnæus.

## The Sturgeons.

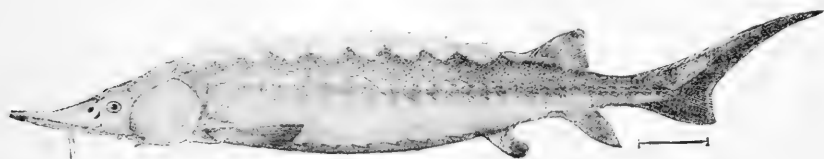
*Key to the species.*

- a. Space between dorsal and lateral shields with stellate plates of rather large size in 5 to 10 series. STURIO  
 aa. Space between dorsal and lateral shields with minute spinules in very many series. BREVIROSTRUM

**Acipenser sturio** Linnæus.

Sturgeon. Mamoose. Mamouche. Moose.

Head about  $3\frac{2}{3}$ ; depth about 7; D. 38; A. 23; snout nearly 2 in head; width of mouth  $5\frac{1}{2}$ ; interorbital space  $3\frac{3}{7}$ ; height



Sturgeon. *Acipenser sturio* Linnæus.

of dorsal along front edge 3; of anal 3; pectoral  $2\frac{1}{4}$ ; ventral  $4\frac{2}{5}$ ; length of caudal peduncle  $3\frac{2}{3}$ ; eye  $3\frac{1}{2}$  over interorbital space; lower lobe of caudal  $2\frac{1}{2}$  in its length. Snout sharp, longer than rest of head. Eye a little elongate. Barbels a little nearer mouth than tip of snout. Nostrils near together in front of eye. Gill-rakers short knobs. Shields not striate strongly, 12 before dorsal, 28 in lateral line and 11 between pectoral and ventral. Skin roughened. Dorsal far back, a little before anal. Caudal ending in a long slender point, lower lobe rounded. Pectoral broad, reaching about one-third of space to ventral. Ventral inserted about last third in space between gill-opening and origin of lower caudal lobe. Olivaceous-gray, paler below. Length  $11\frac{1}{2}$  inches. May of 1898. Riverton, in the Delaware.

Usually in the Delaware and fairly abundant, though I have never observed them above Trenton. The river fishermen still

call the young "mamoose" or "mamouche." Formerly the sturgeon seems to have been more abundant and it was a common occurrence to see them "jump." As late as 1890 frequently four or five large examples were taken during a single day in a large seine. These would run about 150 pounds. The heads were mostly cut off and allowed to rot on the river shore. In the bay about Cape May as many as three have been taken recently in one day. Mr. Wm. J. Fox found them at Sea Isle City.

*Acipenser sturio* Abbott, Nat. Rambles, 1885, p. 479.—Ryder, Bull. U. S. F. Com., VIII, 1888, pp. 235, 242, 266.—Bean, Bull. Am. Mus. Nat. Hist., IX, 1897, p. 331.

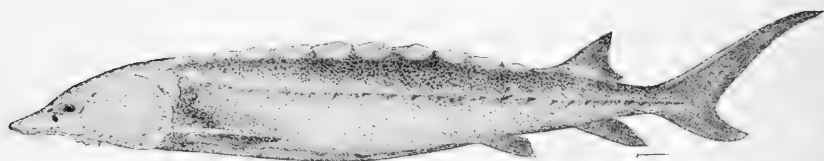
*Acipenser oxyrinchus* Le Sueur, Tr. Am. Philos. Soc. Phila., I, 1818, p. 394.

*Acipenser oxyrhynchus* Abbott, Geol. N. J., 1868, p. 828.

*Acipenser sturio oxyrhynchus* Smith, Bull. U. S. F. Com., XII, 1892, p. 369.

***Acipenser brevirostrum* Le Sueur.**

Short Nosed Sturgeon. Blunt Nosed Sturgeon.



Short Nosed Sturgeon. *Acipenser brevirostrum* Le Sueur.

Body elongated. Head 5 in total, large, convex, variable, in some short in proportion to its breadth and depressed between eyes. Snout short, pointed. Pupil of eye rounded. Barbels 4, flat, in pairs, and nearer nostrils than end of snout. Nostrils near eyes, lower and posterior larger than anterior which is almost round. Skin rough to touch. Scutes in five rows, back with nine in its row, one at base of dorsal, and sides with twenty-six irregular anteriorly enlarged and posteriorly oblong with a small carina. Scutes regular, oblong, radiated, and surmounted by a sharp keel, and rudiments sometimes between. Abdominal plates oblong, small, five on left side, three on right, and placed opposite

center of former. Before each abdominal fin a small tubercle. Skin above blackish tinged with olive, with oblique bands and other corresponding ones of paler on sides. Deep color of upper parts not extending beyond lateral line of scutes. Sides reddish mixed with violet. Abdomen white. Length 2 feet 9 inches, to fork of tail. The Delaware. (Le Sueur.)

I have never seen an example from the state. The detailed account by Ryder will supply all our present information of this and the common species. In the short-nosed species, according to Ryder, the snout is proportionately wider at the base and little or no difference between its form in the young and adult; no smooth area on top of head of young, which is also less deeply concave; small dermal plates between dorsal and lateral rows of scutes never tending to form oblique rows; smaller dermal ossifications never tending to become lozenge-shaped except on sides of upper lobe of caudal fin; dorsal lateral, and ventral scutes not so closely crowded together, few in number and with no preanal plates; skin almost smooth in comparison; mouth very wide; fin formulæ with much fewer radii; lower caudal lobe long; viscera nearly black when exposed, and general color reddish-brown.

Dr. Dahlgren has met with small examples, probably this species, nearly  $2\frac{1}{2}$  feet in length, in the shallow water at the island by Trenton in the Delaware.

*Acipenser brevirostrum* Le Sueur, Tr. Am. Philos. Soc. Phila., I, 1818, p. 290, Pl. 12.

*Acipenser brevirostris* Abbott, Nat. Rambles, 1885, p. 479.—Ryder, Bull. U. S. F. Com., VIII, 1888, p. 236, Pl. 45, fig. 24, Pl. 46, fig. 26, Pl. 47, fig. 28.—Fowler, Proc. Acad. Nat. Sci. Phila., 1901, p. 339.

*Huso brevirostris* Abbott, Geol. N. J., 1868, p. 828.

## Order RHOMBOGANOIDEA.

### The Gar Pikes.

Though known by many fossil forms this order contains but a single living family which I call the *Psallisosomatidae* (=*Lepidosteidae* auct.).

**Family PSALLISOSTOMATIDÆ.****The Gar Pikes.**

Body elongate, subcylindrical. Jaws more or less elongate, spatulate or beak-like, and upper projecting beyond lower. Eyes small. Premaxillary forming most of margin of upper jaw. Maxillary transversely divided into several pieces. Lower jaw composed of as many pieces as in reptiles, and coronoid present. Both jaws with an outer series of small teeth followed by 1 or 2 series of large teeth, besides which on jaws, vomer and palatines, are series of small close-set rasp-like teeth. Large teeth of jaws conical in form, pointed and striate, and placed at right angles to jaw. These teeth resting in a rather deep furrow protected on outside by raised border of jaw, and on inside by a ridge of same nature. They are pierced in center by a foramen which communicates with maxillary canal and through which nerves and blood-vessel enter pulp cavity of tooth. Forms of folded layers of dentine within teeth are peculiar. Pharyngeals with rasp-like teeth. Tongue toothless, short, broad, emarginate, set free at tip. Nostrils near end of upper jaw. Gill-membranes somewhat connected, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers very short. Pseudobranchiæ present. Branchiostegals 3. An accessory gill on inner side of opercle. Air-vessel cellular, lung-like, somewhat functional. Stomach not cæcal. Pyloric appendages numerous. Spiral valve of intestines rudimentary. Body covered with hard rhombic ganoid scales or plates, which are imbricated in oblique series running downward and backward. External bones of skull very hard and rugose. Fins with fulcra. Dorsal fin short, rather high, posterior and nearly opposite anal which is similar in form. Tail heterocercal, in young produced as a filament beyond caudal. Caudal convex. Pectorals and ventrals moderate, few-rayed, and latter nearly midway between former and anal.

Large fishes chiefly of the fresh waters of North America. They are very voracious and therefore destructive to smaller fishes. Not of value as food on account of their rank and tough flesh. In habits sluggish. A single species has been taken in the Delaware tide-water.

Genus *PSALLISOSTOMUS* Walbaum.

## The Gar Pikes.

*Psallisostomus osseus* (Linnæus).

Gar Pike. Gar Fish. Gar.

Head  $3\frac{2}{13}$ ; depth about  $7\frac{3}{4}$ ; D. 8; A. 9; scales about 56 in lateral line to base of caudal; scales 52 between occiput and dorsal; orbit 6 in postocular region;  $4\frac{1}{8}$  over interorbital space; width of head at front edge of opercle  $4\frac{1}{8}$  in its own length; width of snout at gape of mouth  $3\frac{3}{4}$  in its length. Gape more forward, well over half of head. Front margin of orbit in last third of head. Top of head well curved or elevated convexly, flattened medianly. Opercle about as long as high. Scales on anterior portion of side well radiated rugosely. Origin of dorsal about opposite base of seventh anal ray. Length 4 feet 11 inches. Near Trenton in the Delaware. Prof. E. D. Cope.

Upon comparison with examples from the Ohio River I am unable to detect any differences except those which may be attributed to age. *Lepidosteus crassus* Cope seems to have been founded on a middle-sized individual with the radiate or rugose-striate scales apparent. Larger examples show them very pronounced, and younger ones from the Mississippi have the scales entirely smooth, while in examples from Florida which are a little smaller than *crassus* the radiate-rugose scales are becoming evident.

The above example is the only one I have seen from the state. In the upper Delaware tide-water small examples have been reported, and are also occasionally taken in seines. Dr. Abbott tells me it is apparently rare out of brackish water and only 2 or 3 have been taken in purely fresh water since the one described above. Dr. Dahlgren reports having seen a large example, nearly 4 feet long, several years ago in the Delaware at Trenton.

*Lepidosteus osseus* Abbott, Geol. N. J., 1868, p. 822.—Abbott, Am. Nat., IV, 1870, p. 114, fig. 33.—Abbott, Rep. U. S. F. Com., 1875-76, p. 827.—Abbott, Nat. Rambles, 1885, p. 479.

*Lepidosteus crassus* Abbott, Geol. N. J., 1868, p. 823, based on Cope.

## Order ISOSPONDYLI.

## The Isospondylous Fishes.

A large group typified by the herring and trout, and comprising most of the marine soft-rayed fishes, some inhabiting the oceanic abysses, apparently degenerating.

*Key to the sub-orders and families.*

- a. Mesocoracoid well developed.
  - b. (*Clupeoidea*.) No adipose fin.
    - c. Gular plate present between rami of mandible. ELOPIDÆ
    - cc. No gular plate.
      - d. Mouth terminal; maxillary of about 3 pieces; stomach not gizzard-like. CLUPEIDÆ
      - dd. Mouth small, inferior; maxillary simple or nearly so; stomach gizzard-like. DOROSOMATIDÆ
      - ddd. Mouth subinferior, very large, below a tapering pig-like snout; maxillary very long. ENGRAULIDIDÆ
  - bb. (*Salmonoidea*.) Adipose fin well developed.
    - e. Stomach siphonal, not having form or blind sac; pyloric cœca many. SALMONIDÆ
    - ec. Stomach cœcal, of form of blind sac; pyloric cœca generally many. ARGENTINIDÆ
- aa. (*Inioini*.) Mesocoracoid arch wanting or atrophied. SYNODONTIDÆ

## Family ELOPIDÆ.

## The Tarpons.

Body elongate, more or less compressed. Eye large, with adipose eyelid. Premaxillaries not protractile, short. Maxillaries forming lateral margins of upper jaw, composed of about 3 pieces extending backward beyond eye. An elongate bony plate between branches of lower jaw. Mouth broad, terminal, lower jaw prominent. Bands of villiform teeth in both jaws, on vomer, palatines, pterygoids, tongue and base of skull. No large teeth. Opercular bones thin, with expanded membranaceous borders.

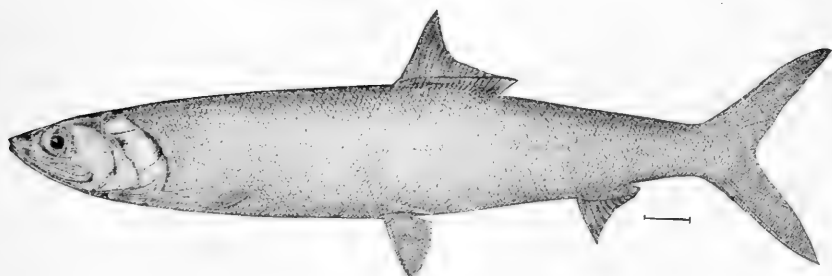
Parietal bones meeting along top of head. Gill-membranes entirely separate, free from isthmus. Branchiostegal rays numerous, 29 to 35. Gill-rakers long and slender. Pseudobranchiæ present or absent. Body covered with silvery cycloid scales, head naked. A scaly occipital collar. Belly not keeled or serrated, rather broad and covered with ordinary scales. Lateral line present. Pyloric ceca numerous. Dorsal fin inserted over or slightly behind ventrals. No adipose fin. Caudal fin forked. Dorsal and anal depressible into a scaly sheath. Pectorals and ventrals each with an accessory long scale.

Large fishes widely distributed in tropical seas, not much valued as food as the flesh is dry and bony. One genus and species known from our coast. The tarpon may also occur but has not been definitely recorded.

Genus *Elops* Linnæus.

The Ten Pounders.

*Elops saurus* Linnæus.



Ten Pounder. *Elops saurus* Linnæus.

Known from the tarpon by the long slender body covered with small scales, large pseudobranchiæ, and last dorsal ray not produced.

The occurrence of this fish is only known to me from Dr. Abbott's reference, which states it to be a rare straggler.

*Elops saurus* Abbott, Geol. N. J., 1868, p. 823.

Family **CLUPEIDÆ**.

## The Herrings.

Body oblong or elongate, more or less compressed. Head usually compressed. Adipose eyelid present or absent. Pre-maxillaries not protractile. Mouth rather large, terminal. Jaws about equal. Maxillaries forming lateral margins of upper jaw, each composed of about 3 pieces. No gular plate. Posterior lower part of opercular region often with an angular emargination, tips of larger branchiostegals abruptly truncate. Gills 4, slit behind fourth. Gill-rakers long and slender. Gill-membranes not connected, free from isthmus. Branchiostegals usually few, 6 to 15. Pseudobranchiæ present. Body covered with cycloid or pectinated scales. Belly sometimes rounded, sometimes compressed, in which case it is often armed with bony serratures. Head naked. No lateral line. Vertebræ 40 to 56. Dorsal fin median or somewhat posterior, rarely wanting. No adipose fin. Ventrals moderate or small. Anal usually rather long. Caudal forked.

A large family inhabiting all seas, usually swimming in immense schools. Some ascend fresh water and some remain there permanently.

*Key to the genera.*

- a.* DUSSUMIERINÆ. Belly rounded, covered with ordinary scales; supplemental maxillary very narrow. ETRUMEUS
- aa.* CLUPEINÆ. Belly compressed, armed with bony serræ; supplemental maxillary broad; A. 15 to 25; dorsal inserted nearly opposite ventral.
  - b.* Scales with entire and rounded posterior margins.
    - c.* Last dorsal ray not produced. CLUPEA
    - d.* Vomer with teeth.
    - dd.* Vomer toothless.
      - c.* Premaxillaries meeting at a large angle so that tip of upper jaw does not appear notched; cheeks longer than deep. POMOLOBUS
      - cc.* Premaxillaries meeting in front at very acute angle so that emarginate tip of upper jaw receives slender tip of lower; fore part of cheeks very deep, deeper than long. ALOSA
      - cc.* Last dorsal produced in a long filament. CLUPANODON
  - bb.* Posterior margins of scales vertical and pectinate or fluted. BREVOORTIA



Genus *ETRUMEUS* Bleeker.

## The Round Herrings.

*Etrumeus teres* (De Kay).

## Round Herring.

Distinguished from all our herrings by the rounded belly.

I have no examples. I follow Dr. Bean in using the *Alosa teres* of DeKay as the oldest available name for this species as Mitchill's *Clupea sadina* was evidently a *Pomolobus*.

*Alosa teres* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 349.

*Etrumeus teres* Abbott, Geol. N. J., 1868, p. 823.—Bean, Bull. U. S. F. Com., VII, 1887, p. 148.

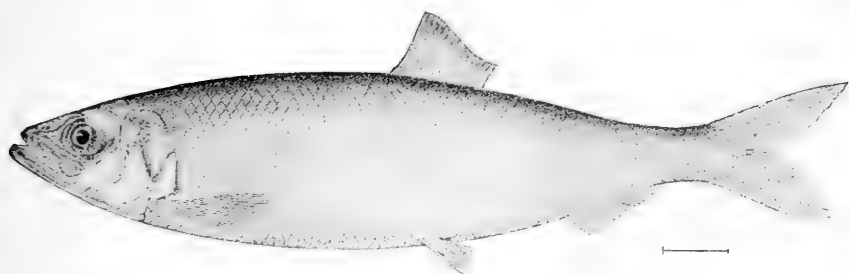
*Etrumeus sadina* Moore, Bull. U. S. F. Com., XII, 1892, p. 358.

Genus *CLUPEA* Linnæus.

## The Herrings.

*Clupea harengus* Linnæus.

## Common Herring.



Common Herring. *Clupea harengus* Linnæus.

From our other herrings, such as the shad and alewives, this one may be distinguished by the presence of vomerine teeth.

I know it only from Dr. Abbott's reference which credits it as of erratic occurrence, though very abundant at times.

*Clupea elongata* Abbott, Geol. N. J., 1868, p. 821.

Genus POMOLOBUS Rafinesque.

The Alewives.

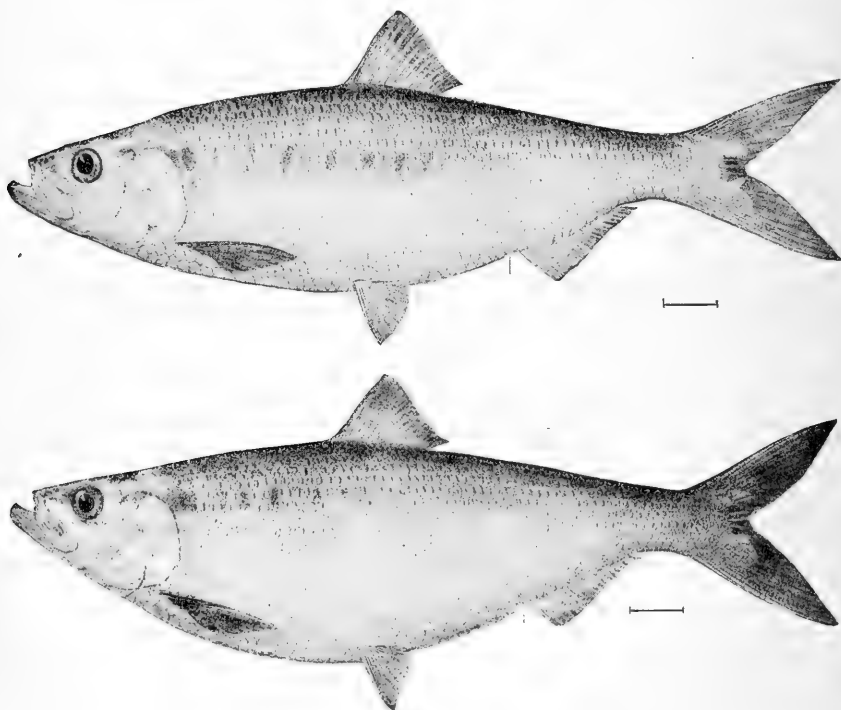
*Key to the species.*

- a. Peritoneum pale.
  - b. Form elliptical; head  $3\frac{3}{4}$ .
  - bb. Form ovoid; head  $4\frac{1}{2}$ .
- aa. Peritoneum black.

MEDIOCRIS  
PSEUDOHARENGUS  
CYANONOTON

**Pomolobus mediocris** (Mitchill).

Shadine. Herring. Fall Herring. Hickory Shad.



Fall Herring. *Pomolobus mediocris* (Mitchill).

(Upper figure male, lower female.)

Head  $3\frac{3}{4}$ ; depth  $3\frac{1}{3}$ ; D. III, 13; A. II, 18; scales about 52 in lateral series to base of caudal; about 16 scales between dorsal and ventral; abdominal scutes  $20 + 15$ ; mandible  $1\frac{5}{6}$  in head; base of anal  $1\frac{2}{3}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $2\frac{1}{4}$ ; least depth of caudal

peduncle  $2\frac{3}{5}$ ; snout  $4\frac{1}{3}$  in head, measured from tip of upper jaw; eye  $3\frac{7}{8}$ ; maxillary  $2\frac{1}{8}$ ; interorbital space 5. Body rather evenly fusiform. Head rather long, attenuated, and profiles about evenly inclined. Mandible protruded well beyond snout. Maxillary reaching nearly opposite posterior margin of pupil, and its greatest expansion about  $\frac{3}{5}$  of orbit. Upper jaw emarginate in front. Interorbital space flattened. Opercular edge of gill-opening moderately emarginate posteriorly and below. Gill-rakers  $10 + 20$ , flattened, equal to filaments. Peritoneum white. Dorsal inserted nearer tip of mandible than base of caudal. Anal low, well behind dorsal. Caudal forked, lower lobe a little longer. Pectoral about  $\frac{5}{7}$  to ventral. Ventral inserted a little behind dorsal, and reaching half way to anal. Color blush-silvery, becoming white below. Sides with faint longitudinal stripes, one to each series of scales, and darker on back. A blue-black blotch on shoulder. On back each stripe has scale it passes over with a dusky center, giving appearance of row of spots in each band. Fins pale, dorsal and caudal tinted with dusky. Length  $11\frac{3}{8}$  inches. Barnegat Pier.

This herring does not ascend the fresh waters to spawn, and is not a highly-valued food-fish. It differs from the alewife in the comparatively longer and elliptical head, and reaches a length of 2 feet. The example described above was taken on a hook baited with "blood worm," the holothurian known as *Caudina*.

*Pomolobus mediocris* Abbott, Geol. N. J., 1868, p. 821.—Bean, Bull. U. S. F. Com., VII, 1887, p. 149.

*Clupea mediocris* Smith, Bull. U. S. F. Com., XII, 1892, p. 368.

*Alosa mattowaca* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 349.

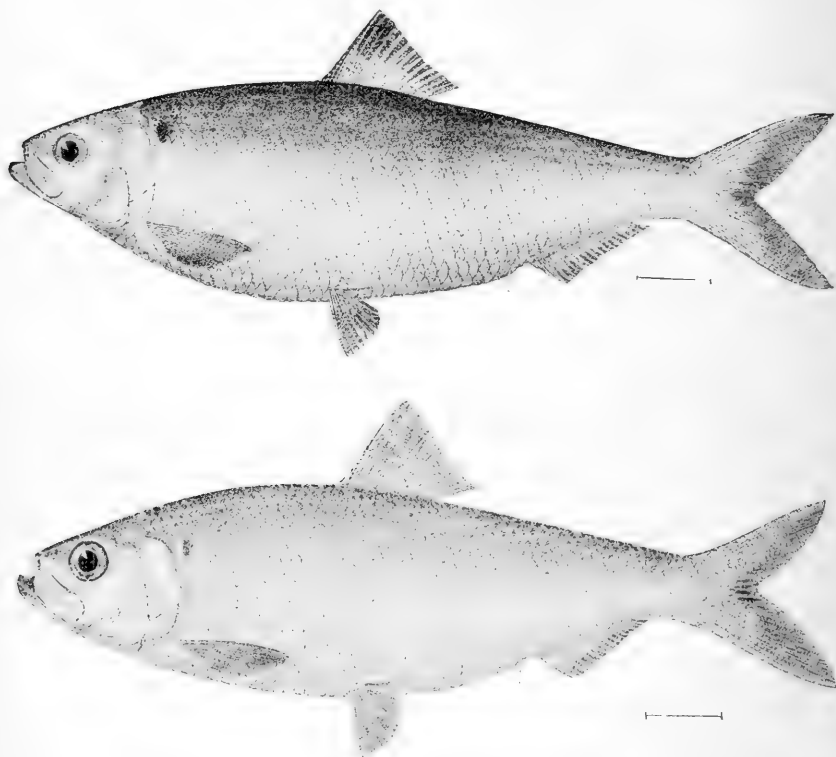
*Melatta mallowocca* Verrill, Am. Nat., V, 1871, p. 398.

***Pomolobus pseudoharengus* (Wilson).**

River Herring. Herring. Alewife.

Head  $4\frac{1}{2}$ ; depth  $3\frac{3}{5}$ ; D. III, 14; A. II, 16; scales about 50 in lateral series to base of caudal; about 14 scales between dorsal

and ventral; abdominal scutes  $20 + 14$ ; mandible  $1\frac{11}{12}$  in head; edge of dorsal anteriorly  $1\frac{2}{3}$ ; base of anal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{3}$ ; ventral 2; least depth of caudal peduncle  $2\frac{1}{2}$ ; snout  $4\frac{2}{3}$  in head measured from tip of upper jaw; eye 4; maxillary  $2\frac{2}{7}$ ; interorbital space  $4\frac{1}{3}$ . Body ovoid, deepest anteriorly. Head attenuated rather superiorly, or lower profile more oblique. Man-



Alewife. *Pomolobus pseudoharengus* (Wilson).

(Upper figure male, lower female.)

dible protruding but slightly. Maxillary reaching posterior portion of pupil, and its greatest expansion about  $\frac{3}{5}$  of orbit. Upper jaw emarginate in front. Interorbital space a little convex. Opercular edge of gill-opening moderately emarginate posteriorly and below. Gill-rakers about  $27 + 48$ , slender, finely dentate, and equal to eye, or longer than filaments. Peritoneum

whitish. Dorsal inserted nearer tip of snout than base of caudal. Anal low, well behind dorsal. Caudal forked, and lower lobe a little longer. Pectoral about  $\frac{3}{5}$  of space to ventral. Ventral behind dorsal, and reaching a little over  $\frac{2}{5}$  of space to anal. Color bluish-silvery, becoming white below. Indistinct darker stripes along rows of scales. A blackish blotch behind opercle. Fins pale, dorsal and caudal tinted with dusky. A breeding male 12 inches long. Great Egg Harbor River at May's Landing. A little larger females with same data show depth 3, opercular emargination deeper, and longer pectoral.

Abundant and ascending the fresh-water streams in the spring. Rarely if ever taken on the hook about Cape May. I found small examples at Cape May early in May. Other species may occur there, but as yet I have not noted them. In the tide-water of the Great Egg Harbor they are abundant, during the spring run, to May's Landing. They do not begin to run much before April. They are retailed for about 15 cents a dozen, and when fresh are good eating, and of fine flavor. The males are smaller and less deeper than the females, though equally numerous. The rounded or deep belly of the female seems to have suggested the name alewife for this species.

They were formerly exceedingly abundant in the Delaware during the spring run. Wagon-loads have been hauled ashore, and on account of not having been disposed of otherwise, have been used as fertilizers. As a fertilizer, after a year's decomposition they prove excellent, especially for the vine, etc. The usual process in this conversion was burial, though if they were dug out of the ground too soon sometimes certain larvæ or worms would appear, which were very disastrous to the trucker or lettuce-grower. These fish are not now taken in such numbers, and as the demand for them does not appear to be so great, a number of the old seines do not run any more. They have been taken as early as February by dip-net fishermen, and frequently occur in the river during March.

*Clupea pseudoharengus* Wilson, Cyclop. Art. S. L. Rees, Am. Ed., IX, 1802-19, no pagination.—Moore, Bull. U. S. F. Com., XII, 1892, p. 359.—Smith, Bull. U. S. F. Com., XII, 1892, p. 368.

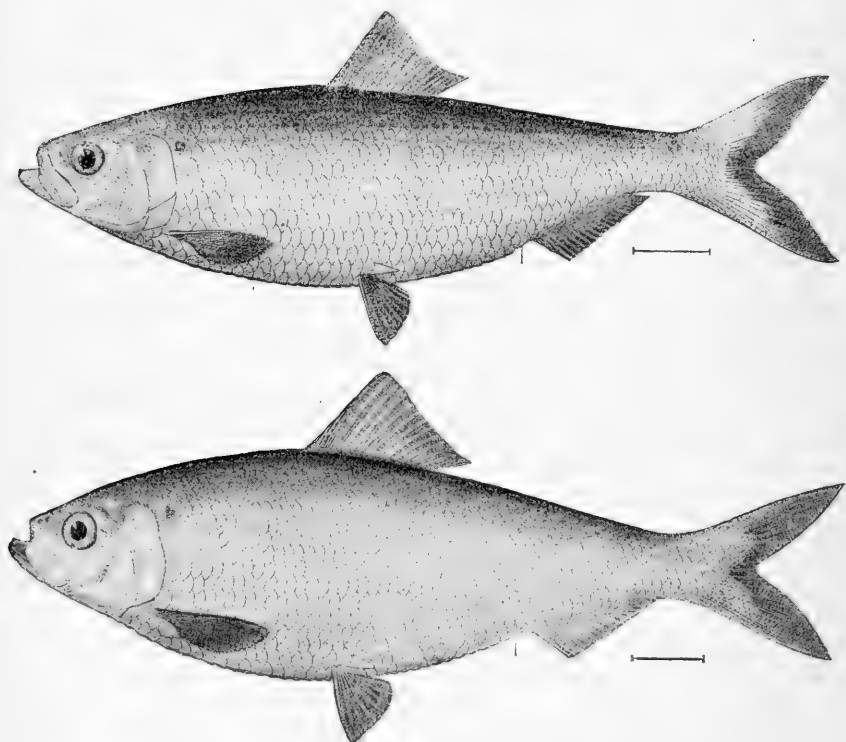
*Pomolobus pseudo-harengus* Abbott, Geol. N. J., 1868, p. 821.

*Pomolobus pseudoharengus* Abbott, Nat. Rambles, 1885, p. 478.

*Alosa tyrannus* Abbott, Am. Nat., IV, 1870, p. 109.

**Pomolobus cyanonoton** (Storer).

Glut Herring. Herring.



Glut Herring. *Pomolobus cyanonoton* (Storer).  
(Upper figure male, lower female.)

Distinguished from our other species by the black peritoneum. It is closer to the alewife but differs in the more elongate body, lower fins, smaller eye and darker back.

I have no examples. It appears on the coast later than the alewife and is less valuable. *Alosa cyanonoton* Storer is evidently the first name available for this species, as *Clupea astivalis* Mitchill = *C. mediocris* Mitchill according to Dr. Bean.

*Clupea astivalis* Bean, Bull. U. S. F. Com., VII, 1892, p. 149.  
—Moore, Bull. U. S. F. Com. XII, 1892, p. 359.—Smith, Bull.  
U. S. F. Com., XII, 1892, p. 368.

Genus *ALOSA* Cuvier.

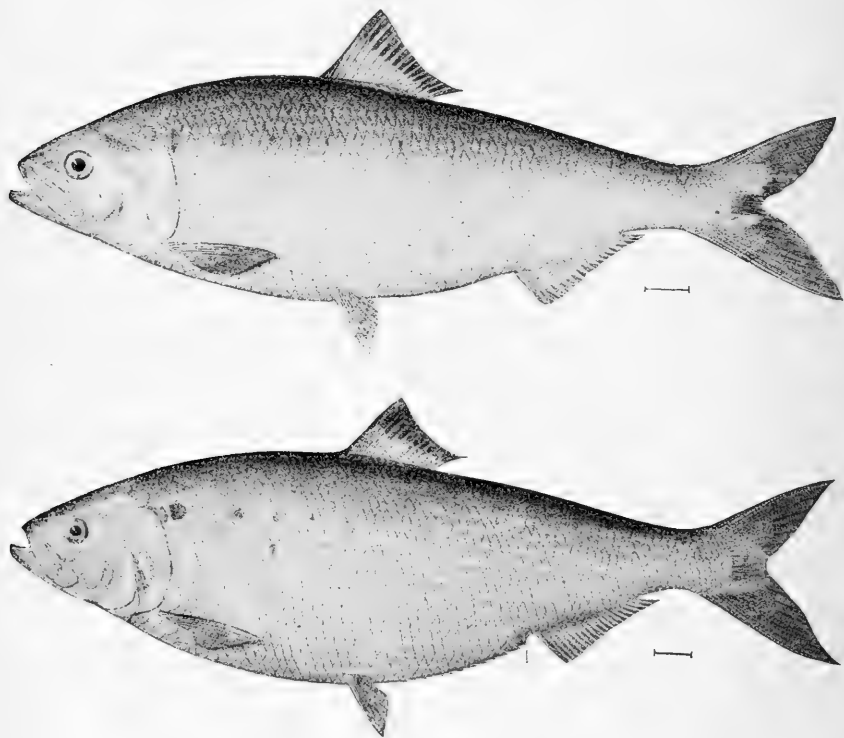
The Shad.

*Alosa sapidissima* (Wilson).

Shad. Jack. Brass Back.

Head 4; depth  $2\frac{7}{8}$ ; D. IV, 13; A. III, 18; scales 56 in lateral series to base of caudal, and about 4 more on latter; 18 scales between dorsal and ventral; abdominal scutes  $22 + 16$ ; mandible  $1\frac{3}{4}$  in head; edge of dorsal anteriorly  $1\frac{3}{4}$ ; base of anal  $1\frac{1}{2}$ ; pectoral  $1\frac{3}{5}$ ; ventral  $2\frac{1}{6}$ ; least depth of caudal peduncle  $2\frac{2}{5}$ ; lower caudal lobe 1; snout 4 in head, measured from tip of upper jaw; eye 4; maxillary 2; interorbital space 4. Body comparatively deep, strongly compressed. Head deep and free portion of cheek deeper than long. Jaws toothless, upper with a sharp deep notch at tip and premaxillaries meeting at a very acute angle. Mandible not protruding. Maxillary reaching about opposite posterior margin of pupil, and its greatest expansion about two-thirds of orbit. Interorbital space convex. Opercular edge of gill-opening deeply incised below. Gill-rakers  $40 + 70$ , very long, slender, inner finely denticulate, and longest much longer than longest filaments or about equal to snout. Peritoneum white. Dorsal inserted nearer tip of snout than base of caudal. Anal inserted nearer base of caudal than origin of ventral, low, and first rays but little elevated. Lower caudal lobe a little larger. Pectoral small, about four-sevenths of space to ventral. Ventral inserted behind dorsal and a little less than two-fifths of space to anal. Color bluish on back, otherwise silvery-white. A slaty or dusky blotch behind opercle followed by a series of indistinct blotches of pale slaty, and in some lights several smaller series below, though very faint. Dorsal and caudal tinted with dusky, other fins pale. Iris silvery. Length 23 inches. Delaware River.

Color of the above when fresh, brownish on back, in some lights of ecru-drab tint, in other more olive, and most all overshot with bright silvery or metallic reflections. Margin of each scale till about level with eye more or less distinctly olivaceous, made up of fine or minute dusky dots which become more sparse and paler or with a nearly faded appearance as they approach the lower costal region. In fact they do not descend below the origin of



Shad. *Alosa sapidissima* (Wilson).

(Upper figure male, lower female.)

the pectoral. In some lights back is overshot with beautiful brassy, blue and golden reflections, and in others they incline to delicate purple. This is especially noticeable on cheek and region of peritoneum. Head beautiful olivaceous above tinted with golden, this latter shade extending down on opercles. Jaws and adipose eyelid pale translucent brownish. After death sides of



body frequently take on a Nile-blue effect or pale blue tint, this shade spreading well over the abdomen. The back becomes more purplish-brown with alternate streaks of pale and darker following, latter greater in width, to courses of scales. Top of head darker than back, its upper surface more olivaceous and this color fading out into brassy on side of snout. Rim inside of mandible, also edges of rami inside, especially posteriorly, and upper surface of tongue dusky. Except former is blackish this region is translucent brownish. Dorsal pale translucent brownish, margin broadly dusky, especially of upper anterior rays. Anteriorly and a little below middle of fin a pale or indistinct longitudinal streak of same color to last ray, most distinct on membranes. Caudal dusky, this color most distinct on posterior margin, its lower margin whitish, especially basally. Basal scaly region of caudal pale and more or less translucent. Pectoral, ventral and anal translucent whitish, bases of former two fins pale pinkish. Upper rays of pectoral inside sprinkled with dusky dots. Inside of gill-openings whitish. Lower surface of body, together with that of caudal peduncle, clear shining whitish. Female.

This well-known fish is perhaps the most important of Delaware River food-fishes. Its habits, life history, etc., have been treated so frequently by persons more interested in its commercial value that I have little save a repetition of what has already been said. Though mostly associated with the alewife and ascending the large tide-water streams in the spring for the purpose of spawning, they are more of an object to the many large fisheries. As a food-fish they rank high and are of excellent flavor, though not oily but with many small bones. I have never found them land-locked in ditches and pools like the alewife. About Cape May they vary somewhat in abundance, sometimes only a few are taken in the bay-pounds. Fishermen report them occasionally in the tide-water of the Great Egg Harbor River. They have been taken in both the lower Rancocas and Crosswicks tide-waters.

*Clupea sapidissima* Wilson, Cyclop. Art. S. L. Rees, Am. Ed., IX, 1802-19, no pagination.—Moore, Bull. U. S. F. Com., XII, 1892, p. 358.—Smith, Bull. U. S. F. Com., XII, 1892, p. 369.

*Alosa sapidissima* Abbott, Geol. N. J., 1868, p. 821.—Abbott, Nat. Rambles, 1885, p. 478.—Bean, Rep. Forest, Fish and Game Com., N. Y., 1901, p. 305.

*Alosa præstabilis* Abbott, Am. Nat., IV, 1870, p. 115.

### Genus CLUPANODON Lacépède.

#### The Thread Herrings.

##### *Clupanodon oglinum* (Le Sueur).

#### Thread Herring.

Head 4; depth 3; D. IV, 15; A. III, 21; scales 45 in lateral series to base of caudal; 12 scales between dorsal and ventral; abdominal scutes 17 + 17; snout 4 in head; eye  $3\frac{4}{5}$ ; maxillary  $2\frac{1}{2}$ ; interorbital space  $4\frac{1}{3}$ ; base of dorsal  $1\frac{1}{2}$ ; base of anal  $1\frac{1}{3}$ ; least depth of caudal peduncle  $2\frac{2}{3}$ ; pectoral  $1\frac{2}{3}$ ; ventral  $2\frac{2}{5}$ . Body with greatest depth at origin of dorsal or anterior in length, and lower profile evenly convex. Head deep, compressed, upper profile less inclined than lower. Eye small. Maxillary reaching first two-fifths of orbit. Jaws even, without teeth. Interorbital space flattened. Opercular edge of gill-opening with a deep gash below. Gill-rakers numerous, about 50 + 90, longest two-thirds of orbit. Belly strongly serrate. Scales narrowly imbricate. Dorsal inserted about midway between tip of snout and middle of anal and last ray prolonged, three in head and trunk. Anal low, inserted nearly midway between origin of ventral and base of caudal. Caudal forked, lobes slender, pointed and lower longer. Pectoral two-thirds of space to ventral, which reaches three-eighths of space to anal. Color bluish above, sides and below silvery. A bluish shoulder-spot. Each scale on back with distinct dusky spot, forming longitudinal rows. Dorsal and caudal grayish, tips of lobes black, other fins pale. Length  $8\frac{1}{4}$  inches. Sea Isle City.

Color of the above when fresh, back slaty with a very dull tinge of hyaline in some lights, in others flashes of metallic bluish and purplish. Longitudinal dorsal streaks four, without

median line, varying from plumbeous-dusky to rather deep tints of the latter in certain places, though noticeably on predorsal region and base of caudal peduncle above. Varying slaty tints also extend out on caudal, edge of lower lobe of which is whitish. Top of head transparent with hyaline tints. End of snout and tip of mandible dusky. A blackish bar obliquely back from above eye posteriorly. Side of head and body silvery-white, former and all of latter medianly overshot with dull brassy. Occiput with a dash of blackish and a large blackish blotch on shoulder just behind gill-opening above. Iris silvery, with blackish above. Dorsal fin greenish-olive, margin above blackish, narrow anterior margin slaty and filament same color. Each caudal lobe with a tinge of greenish-olive medianly, and each tip shading into blackish marginally, caudal otherwise more or less grayish. Anal, pectoral and ventral transparent white. Serratures whitish. Adipose eyelid transparent.

Occasionally along our coast. Easily distinguished from our other species by the long posterior dorsal ray. The above described example was obtained by Mr. Wm. J. Fox.

*Opisthonema oglinum* Bean, Bull. U. S. F. Com., VII, 1887, p. 149, from Baird.—Moore, Bull. U. S. F. Com., XII, 1892, p. 359.

*Chatæssus signifer* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 349.

*Clupanodon thrissa* Abbott, Geol. N. J., 1868, p. 821.

## Genus BREVOORTIA Gill.

### The Menhadens.

**Brevoortia tyrannus** (Latrobe).

#### PLATE 6.

Menhaden. Bunker. Mossbunker. Bony Fish.  
American Club Fish. Shadine. Ocean Trout. Hard Head.  
Mossbanker. Banker.

Head 3; depth  $2\frac{4}{5}$ ; D. 11, 17; A. 11, 17; scales about 52 to base of caudal, many more crowded on latter; abdominal scutes,

20 + 12; snout  $4\frac{2}{3}$  in head; eye 5; maxillary  $2\frac{1}{8}$ ; interorbital space 4; pectoral  $1\frac{4}{5}$ ; ventral  $3\frac{5}{6}$ ; least depth of caudal peduncle  $3\frac{1}{3}$ . Body elliptical, compressed, deepest anteriorly and tapering posteriorly. Head very large, short and heavy. Snout short. Adipose eyelid very large. Mouth large. Jaws about even, no teeth. Interorbital space convex. Cheeks deeper than long. Gill-rakers very long and slender, densely set, and appearing to fill mouth when it is opened, much longer than eye. Gill-arches angularly bent. Scales deeper than long, closely imbricated, and exposed edges vertical, fluted or pectinated, especially those before dorsal. Intestinal canal elongate. Peritoneum dusky. Dorsal inserted a little nearer base of caudal than tip of snout, its height equals maxillary. Anal beginning close behind dorsal. Pectoral about  $\frac{3}{4}$  of space of ventral. Ventral inserted opposite origin of dorsal and reaching not quite half way to anal. Color bluish above, and sides and lower surface silvery. Sides brassy. A dusky scapular blotch with a number of smaller spots following on costal region above. Fins pale. Length  $9\frac{7}{8}$  inches. Atlantic City.

Plentiful at times at Cape May, though apparently scarce as compared with its former abundance. Now used altogether as bait in many places. Previously great numbers were taken and deposited by wagon-loads as fertilizers. Though occurring now in small-sized schools, they are generally to all appearances fatter in the fall. I have found them abundant in both winter and spring off Sea Isle City. As they are surface swimmers they frequently fall a prey to the fish hawk. Of no account as a food-fish, but of use for the oil and as fertilizers. At one time they were especially abundant in the inlet about the sewers of Atlantic City, where they fed on refuse, swimming close to the surface in large schools and producing quite a commotion.

*Brevoortia tyrannus* Bean, Bull. U. S. F. Com., VII, 1887, p. 149.—Moore, Bull. U. S. F. Com., XII, 1892, p. 359.—Smith, Bull. U. S. F. Com., XII, 1892, p. 369.

*Alosa menhaden* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 347.—Cook, Geol. Cape May, 1857, p. 113.

*Brevoortia menhaden* Abbott, Geol. N. J., 1867, p. 822, from Cook.

## Family DOROSOMATIDÆ.

## The Gizzard Shad.

Body short, deep, strongly compressed. Head short, rather small. Snout blunt, overlapping small inferior oblique mouth. Eye with adipose eyelid. Teeth minute. Maxillary narrow, short, with single supplementary bone not extending to opposite middle of eye and forming but small portion of lateral margin of upper jaw. Premaxillaries not protractile. Mandible short and deep, rami enlarged at base. Gill-membranes not united, free from isthmus. Gill-rakers slender, exceedingly numerous, not very long, and similar on all arches. Pseudobranchiæ large. Branchiostegals about 6. Body covered with thin deciduous cycloid scales. Belly compressed to an edge which is armed with bony serratures. No lateral line. Vertebræ 49. Stomach short, muscular, like gizzard of a fowl. Dorsal fin about midway in body, usually behind ventrals. Anal very long, low. Caudal forked. Pectorals and ventrals moderate, each with an accessory scale. No adipose fin.

Mud-eating fishes of the coasts and rivers of warm regions, of little value as food. One genus and species in our waters.

## Genus DOROSOMA Rafinesque.

## The Gizzard Shad.

*Dorosoma cepedianum* (Le Sueur).

## PLATE 7.

## Gizzard Shad. Hickory Shad. Mud Shad.

Head  $3\frac{7}{8}$ ; depth  $2\frac{2}{3}$ ; D. IV, 9, 1; A. II, 29, 1; P. I, 15; V. I, 7; scales 55 in lateral series from gill-opening to base of caudal, several more on latter; about 31 series of scales before dorsal; 20 series of scales transversely between origin of dorsal and middle of belly; 8 series of scales vertically on caudal peduncle

anteriorly; width of head, 2 in its length; depth of head 1; snout 6; eye  $3\frac{3}{4}$ ; maxillary  $3\frac{1}{4}$ ; mandible  $2\frac{7}{8}$ ; interorbital space 4; first developed dorsal ray  $1\frac{7}{8}$ ; lower caudal lobe 1; first developed anal ray  $2\frac{5}{6}$ ; pectoral  $1\frac{1}{5}$ ; ventral 2; least depth of caudal peduncle  $2\frac{1}{3}$ ; base of anal  $3\frac{2}{3}$  in head and trunk. Body compressed, rather deep, somewhat ovoidly rhomboid, and greatest depth about origin of dorsal. Nuchal and thoracic regions bulging a little on anterior profiles. Caudal peduncle compressed, its least depth equal to its length, from base of last anal ray. Head rather small, compressed and deep, obtuse in front. Profiles similarly inclined. Snout short, obtusely convex in profile, and somewhat compressed. Eye rather large, anterior, circular, and about midway in depth of head. Adipose eyelid well developed, the exposed portion of eye a little less than half its diameter. Mouth a little inferior, upper jaw produced beyond mandible, and maxillary reaching about opposite front margin of pupil. A groove along side of mandible obliquely back from below posterior extremity of maxillary. Teeth in narrow bands in jaws, and minute. Vomer and palatines edentulous. Tongue rather large, triangular, thick, free marginally, but with median frenum extending well forward so that it is adnate with floor of mouth. Rami of mandible well elevated inside of mouth. Nostrils together, lateral, and near front margin of eye. Upper surface of head adipose-like over eye, and interorbital space well elevated convexly. Symphysis of mandible with a tubercle, fitting in a depression in upper jaw when mouth is closed. Gill-opening extending forward till not quite opposite front rim of pupil. Rakers  $135 + 110?$ , fragile, slender, short, longest  $\frac{4}{7}$  longest filaments which are a little shorter than orbital diameter. Pseudobranchiæ nearly twice as long as longest rakers. Isthmus a little broad, with flattened surface. Scales large, narrowly imbricated, cycloid, and forming nearly horizontal series, those in front of dorsal not completely crossing over, but leaving a narrow naked strip medianly on back. Head naked. Abdomen medianly from gill-opening to vent with 30 robust keeled serratures. Fins naked, except base of caudal, which is covered with small scales. Small scales along base of anal forming a low

sheath. A pointed flap of two scales at axil of pectoral equal to about  $\frac{1}{3}$  length of fin. Ventral with a pointed scaly flap a little less than half length of fin. Vent well posterior, close in front of anal. Dorsal inserted a little nearer base of last anal ray than tip of snout, first branched ray longest and last longer than its antecedents to third branched ray. Anal inserted behind base of dorsal or nearer base of caudal than origin of pectoral, anterior rays longest and its margin nearly straight. Caudal deeply forked, lobes pointed and lower longer. Pectoral broad, reaching beyond ventral. Ventral inserted well before origin of dorsal or nearer that of pectoral than that of anal and extending  $\frac{4}{7}$  of space to latter.

Color in alcohol-dull brown, more or less uniform, a trifle darker on back. Fins plain pale brown. Iris pale brassy. Length  $14\frac{3}{4}$  inches. No. 23,030, Academy of Natural Sciences of Philadelphia. Female. Type (cotype) of *Chatassus insociabilis* Abbott. Sturgeon Pond, situated two miles below Trenton. Dr. Charles C. Abbott. Also No. 23,031, Academy of Natural Sciences of Philadelphia. Male. Cotype with same data. It is a trifle smaller, and has the last dorsal ray produced till about equal to the head in length.

These are the only examples I have seen. They may differ, as contended by Dr. Abbott, to represent a land-locked race, though I have not had the opportunity to compare them with other New Jersey examples. According to the original account there is a very deep glossy black opercular spot which implies that such is not a character of youth as some writers would suppose. In the Delaware they are reported formerly abundant, and though occurring there all winter they do not appear in any numbers till after the breaking up of the ice. They always swim in large schools, and are not used as food. It is unlawful at present to take them for fertilizers. At Duck Island they have been taken in great numbers even as late as November. Dr. C. C. Abbott thinks they may spawn in Crosswicks Creek, as some fishermen have claimed to have seen the young. The vernaculars of this fish, such as mud shad, denote the habit of the fish being found in the mud during winter, the name gizzard shad has reference

to the muscular stomach, and hickory shad has reference to their appearance in the spring, when the hickory trees blossom.

*Megalops cepedianus* Le Sueur, Journ. Acad. Nat. Sci. Phila., I, 1818, p. 361.

*Dorosoma cepedianum* Abbott, Geol. N. J., 1868, p. 822.—Abbott, Amer. Nat. IV, 1870, pp. 109, 110, 116, fig. 31.

*Dorysoma cepedianum* Abbott, Nat. Rambles, 1885, p. 478.

*Chatassus insociabilis* Abbott, Proc. Acad. Nat. Sci. Phila., 1860, p. 365.

### Family ENGRAULIDIDÆ.

#### The Anchovies.

Body elongate, more or less compressed. Head compressed. Snout pointed, compressed, usually pig-like and overlapping mouth. Eye large, well forward, without adipose eyelid. Pre-orbital narrow. Mouth extremely large, more or less oblique. Gape very wide, maxillary very long and slender, extending backward far behind eye, sometimes beyond head. Premaxillaries not protractile, very small and firmly joined to maxillaries. Teeth usually small, sometimes obsolete, usually fine and even, uniserial in jaws, and canines sometimes present. Opercles thin and membranaceous. Gill-membranes separate or joined, free from isthmus. Gill-rakers long and slender. Pseudobranchiæ present. Branchiostegals slender, 7 to 14 in number. Body covered with thin cycloid scales. No lateral line. Belly rounded or weakly serrate. Fins various. Dorsal usually short and median. No adipose fin. Caudal forked.

Small carnivorous shore-fishes usually swimming in large schools on sandy shores, and sometimes entering rivers.

#### Genus ANCHOVIA Jordan and Evermann.

#### The Silvery Anchovies.

#### *Key to the species.*

a. Base of dorsal not entirely in front of anal.

b. Developed or branched anal rays 17 to 18; lateral silvery band broad.

c. Depth 6; eye 4.

EURYSTOLE



cc. Depth  $4\frac{3}{5}$ ; eye  $3\frac{1}{2}$ .

BROWNII

bb. Developed or branched anal rays 25; lateral silvery band narrow.

MITCHILLI

aa. Base of dorsal entirely in front of anal.

DUODECIM

**Anchovia eurystole** (Swain and Meek).

Head  $3\frac{1}{2}$ ; depth 6; D. II, 10; A. II, 18; scales 36 from gill-opening to base of caudal; about 8 scales obliquely back from origin of dorsal; snout  $4\frac{1}{9}$  in head; eye  $4\frac{1}{9}$ ; maxillary  $1\frac{1}{5}$ ; pectoral  $2\frac{1}{5}$ ; ventral  $2\frac{3}{4}$ ; height of dorsal at first branched ray  $1\frac{5}{6}$ ; of anal 2; least depth of caudal peduncle  $3\frac{1}{10}$ . Body elongate, slender. Belly not serrated. Least depth of caudal peduncle but little more than half its length. Head pointed. Snout rather sharp. Eye small, not larger than snout. Dorsal inserted about midway between front of eye and base of caudal. Anal begins below last dorsal rays. Caudal forked. Pectoral a little more than half way to ventral, and latter same to anal. Color apparently uniform. Length about  $1\frac{3}{8}$  inches. Ocean City and Longport. (Bean's figure.)

Known from our coast by the young examples reported by Dr. Bean. Provisionally the identity of this species with *Engraulis argyrophanes* Valenciennes may be questioned.

*Stolephorus eurystole* Bean, Bull. U. S. F. Com., VIII, 1887, p. 150, Pl. I, fig. 1.—Smith, Bull. U. S. F. Com., XII, 1892, p. 369.

**Anchovia brownii** (Gmelin).

## Anchovy.

Head  $3\frac{5}{6}$ ; depth  $4\frac{3}{5}$ ; D. II, 13; A. IV, 17; scales about 40 to base of caudal; about 8 scales between dorsal and anal; snout  $4\frac{2}{5}$  in head; eye  $3\frac{1}{2}$ ; maxillary  $1\frac{1}{4}$ ; interorbital space 4; base of anal  $1\frac{1}{6}$ ; lower caudal lobe 1; least depth of caudal peduncle  $2\frac{2}{3}$ ; pectoral  $1\frac{2}{3}$ ; ventral  $2\frac{2}{3}$ . Body elongated, compressed, and not elevated. Head short. Snout long, well protruding. Eye large. Teeth rather strong. Maxillary reaching beyond base of mandible but not quite to gill-opening. Cheek triangular. Interorbital space a little convex. Gill-rakers long,  $20 + 22$ ,

longest  $\frac{2}{3}$  of orbit. Belly compressed, serrulate. Dorsal inserted nearer base of caudal than tip of snout. Anal in a scaly sheath, beginning about midway under dorsal. Caudal forked, lobes sharp. Pectoral and ventral falling well short of succeeding fins. Color translucent grayish with a broad silvery band becoming nearly equal to orbit in width posteriorly. Orbit bright silvery. Dorsal and caudal shaded marginally with a little pale dusky. Length  $3\frac{7}{8}$  inches. Ocean City.

In life general color of the above translucent sandy-brown, and back when viewed from above with a brilliant emerald streak in form of reflection longitudinally. Lateral band from shoulder to caudal, and head, brilliant mercury or silvery. Iris silvered white. Fins pale translucent brown, caudal and base of anal dusted with pale dusky.

Found in the surf at the above locality, though less abundant than the following.

*Stolephorus browni* Bean, Bull. U. S. F. Com., VII, 1887, p. 149.—Moore, Bull. U. S. F. Com., XII, 1892, p. 359.—Smith, Bull. U. S. F. Com., XII, 1892, p. 369.

*Engraulis vittata* Baird, 9th An. Rep. Smiths Inst., 1854, p. 347.—Abbott, Geol. N. J., 1868, p. 822.—Verrill, Am. Nat., V, 1871, p. 398.

**Anchovia mitchilli** (Valenciennes).

Sperlin.



Sperlin. *Anchovia mitchilli* (Valenciennes).

Head  $4\frac{1}{8}$ ; depth  $4\frac{1}{4}$ ; D. II, 12; A. III, 25; scales about 40 to base of caudal; 7 scales between dorsal and anal; snout  $4\frac{1}{2}$  in head; eye 3; maxillary  $1\frac{1}{6}$ ; interorbital space  $4\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{10}$ ; pectoral  $1\frac{2}{5}$ ; ventral  $2\frac{3}{4}$ . Body a little short, compressed. Head short, blunt, compressed. Snout short, its length about equal to pupil. Eye very large.

Teeth in both jaws fine. Maxillary nearly reaching gill-opening. Cheek rather broadly triangular. Interorbital space convex. Gill-rakers long,  $20 + 23$ , longest about  $\frac{2}{3}$  of orbit. Belly compressed and slightly serrulate. Dorsal inserted nearer base of caudal than tip of snout. Anal begins close after dorsal and its base greater than head. Caudal forked. Pectoral reaching ventral, and latter half way to anal, though not to origin of dorsal. Translucent, with an ill-defined narrow silvery band hardly greater in width than pupil. Length  $2\frac{5}{8}$  inches. In the Delaware River off Fort Delaware.

I have many examples from the above locality and Beesley's Point, where it seems to be abundant. It is also very abundant in the surf at Ocean City in company with *Anchovia broxnii*, though never attaining to such a large size. It is also somewhat brassy in color in life.

*Stolephorus mitchilli* Bean, Bull. U. S. F. Com., VII, 1887, p. 149.—Moore, Bull. U. S. F. Com., XII, 1892, p. 359.—Smith, Bull. U. S. F. Com., XII, 1892, p. 369.

***Anchovia duodecim* (Cope).**

Head  $3\frac{1}{2}$ ; depth 4; D. III, 9; A. IV, 25; scales about 35 to base of caudal, and 3 more on latter; 8 scales between dorsal and anal; snout  $5\frac{1}{4}$  in head; eye  $4\frac{1}{2}$ ; maxillary  $1\frac{2}{7}$ ; interorbital space  $3\frac{3}{4}$ ; base of dorsal  $2\frac{1}{3}$ ; length of depressed dorsal  $1\frac{1}{4}$ ; base of anal  $1\frac{1}{10}$ ; upper caudal lobe  $1\frac{1}{10}$ ; least depth of caudal peduncle  $2\frac{3}{5}$ ; pectoral  $1\frac{3}{5}$ ; ventral 2. Body rather short, deep, well compressed and back a little elevated with convex profile anteriorly. Head short, deep. Snout rather short, blunt and little projecting. Diameter of pupil about  $\frac{2}{3}$  of snout. Teeth fine in both jaws. Maxillary not quite reaching gill-opening. Cheek rather narrowly triangular. Interorbital space convex. Gill-rakers long,  $17 + 19$ , longest equal to orbit. Belly with compressed serrulate edge. Origin of dorsal midway between tip of snout and base of caudal, base of fin entirely before beginning of anal. Anal in a scaly sheath and its insertion falling a little nearer base of caudal than origin of pectoral. Caudal deeply forked, lobes pointed. Pectoral reaching a little beyond base of

ventral. Ventral extending  $\frac{2}{3}$  of space to anal. Silvered whitish in color in spirits, and with no trace of a longitudinal silvery band. Length  $3\frac{7}{8}$  inches. Beesley's Point. Type of *Engraulis duodecim* Cope.

This species is only known from the example described above, and differs from *Anchovia mitchilli*, with which it has been united by Drs. Jordan and Evermann, in many respects. Chief among these may be mentioned the anterior position of the dorsal fin, which is altogether in advance of the anal.

*Engraulis duodecim* Cope, Tr. Am. Philos. Soc. Phila., XIII, 1869, p. 405.—Abbott, Geol. N. J., 1868 (1869), p. 822, from Cope.

### Family SALMONIDÆ.

#### The Salmons.

Body oblong or elongate, and abdominal profile rounded. Mouth terminal, large or small. Maxillary forming lateral margin of upper jaw, provided with a supplemental bone. Premaxillaries not protractile. No barbels. Teeth various, sometimes absent. Gill-membranes not connected, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers various. Pseudobranchiæ present. Branchiostegals 10 to 20. Parietals not in contact, separated at middle by intervention of supraoccipital, which connects with frontals. Epipleural appendages not developed. Air-vessel large. Stomach siphonal. Pyloric cæca very numerous. Ova large, falling into cavity of abdomen before exclusion. Body covered with cycloid scales. Head naked. Lateral line present. Dorsal usually nearly median, not greatly elongate, its rays 9 to 15, only 1 or 2 of anterior simple or rudimentary, others branched. Adipose fin present. Caudal forked. Anal moderate or rather long. Pectorals placed low. Ventrals moderate, nearly median.

Ranking easily among the first of fishes, many of the members of this family have long been known for their beauty of color, activity and gaminess, and interest to the true sportsman. As food-fishes they are excellent, both as to quality and quantity, for some of the species are of large size and very numerous. They

are confined to northern regions north of about  $40^{\circ}$  N. Some species, especially larger ones, are marine and anadromous, living and growing in the sea and entering fresh waters to spawn. Still others live in running brooks, entering lakes or the sea as occasion serves, but not habitually doing so. Others again are lake-fishes, approaching the shore or entering brooks in the spawning season, at other times retiring to waters of considerable depth. The large size of the eggs and their lack of adhesiveness, with the ease by which the eggs may be impregnated, render the salmon and trout especially adapted for artificial culture. *Salmonidae* are of comparatively recent evolution and are only found in recent deposits. But a single species in our brooks, though others have been introduced.

Genus SALVELINUS Richardson.

The Charrs.

*Salvelinus fontinalis* (Mitchill).

PLATE 8.

Trout. Brook Trout.

Head  $3\frac{5}{8}$ ; depth 4; D. III, 10; A. III, 8; pores in lateral line 110 to base of caudal and 2 more on latter; snout  $3\frac{3}{5}$  in head; eye  $5\frac{3}{5}$ ; maxillary  $1\frac{4}{7}$ ; interorbital space  $3\frac{3}{5}$ ; length of depressed dorsal  $1\frac{2}{7}$ ; of anal  $1\frac{4}{7}$ ; least depth of caudal peduncle  $1\frac{2}{5}$ ; caudal  $1\frac{1}{3}$ ; pectoral  $1\frac{1}{2}$ ; ventral 2. Body moderately elongate, oblong, moderately compressed, and not much elevated. Head large, not long. Snout conic. Eye small, a little superior. Mouth large. Maxillary reaching for more than half an eye-diameter beyond eye. Jaws, palatines and tongue with conic teeth. Vomer boat-shaped, shaft much depressed, without raised crest, and teeth on head of bone, none on shaft. Interorbital space convex. Gill-rakers 7 + 11 short stumps. Scales very small. more than 200 in a lateral series. Dorsal inserted nearer tip of snout than base of caudal. Adipose fin small, over last anal rays. Anal inserted nearly midway between insertion of dorsal and

base of caudal. Pectoral four-sevenths of space to ventral. Ventral inserted a little behind dorsal. Caudal slightly lunate. Dark olive above. Sides with many red spots, usually smaller than pupil. Back more or less barred or mottled with shade darker than ground-color. Dorsal and caudal barred or mottled with darker. Lower fins dusky with edges anteriorly orange followed by dark streak. Belly red. Length  $1\frac{3}{8}$  inches. Morris county.

A beautiful fish, of clear cold streams and best suited to the northern counties, and the chief object of pursuit to the true angler. Its beauty and combined characters of excellence as both a table-fish and game-fish have led to its introduction into streams not originally stocked.

*Salmo fontinalis* Abbott, Geol. N. J., 1868, p. 821.

### Family ARGENTINIDÆ.

#### The Smelts.

Body elongate and abdomen rounded. Mouth terminal, small or large, formed as in *Salmonidæ*, the maxillary forming margin of upper jaw. Teeth various, sharp-pointed. No barbels. Gill-membranes separate, free from isthmus. Gills four, slit behind fourth. Branchiostegals five to ten. Stomach a blind sac with pyloric cœca few or none. Air-vessel single, large. Ova large, falling into cavity of abdomen before extrusion. Body covered with moderate or small scales which are usually cycloid. Head naked. Lateral line present. No phosphorescent spots. Dorsal fin short, nearly median. Adipose fin always present. Anal moderate. Caudal forked. Pectorals placed low. Ventrals moderate, nearly median. No spines in fins.

Small marine or anadromous fishes, some in deep water mostly of the northern hemisphere. They are really reduced *Salmonidæ*, more feeble and smaller than the trout in every way, but similar in all respects except in the form of the stomach. Most are delicate and valuable food-fishes. A single species in our waters.

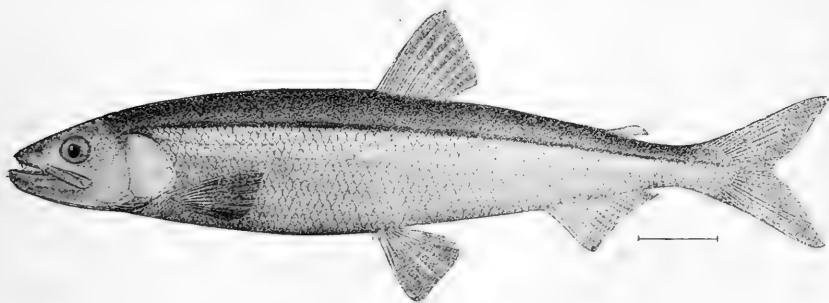
Genus *OSMERUS* Linnæus.

## The Smelts.

*Osmerus mordax* (Mitchill).

Smelt. Frost Fish. Silver Pike.

Head 4; depth  $5\frac{3}{4}$ ; D. III, 8; A. III, 13; scales 62 in lateral line to base of caudal; 6 scales between origin of dorsal and lateral line; 5 scales between lateral line and origin of ventral; mandible  $1\frac{3}{5}$  in head; third dorsal ray  $1\frac{3}{7}$ ; base of anal  $1\frac{3}{5}$ ; lower caudal lobe  $1\frac{1}{6}$ ; least depth of caudal peduncle 4; pectoral  $1\frac{2}{5}$ ; ventral  $1\frac{2}{3}$ ; snout 4 in head measured from tip of upper

Smelt. *Osmerus mordax* (Mitchill).

jaw; eye  $4\frac{1}{2}$ ; maxillary  $1\frac{4}{5}$ ; interorbital space  $3\frac{3}{4}$ . Body long, slender. Head long, pointed, large. Snout long, convex. Mouth large. Mandible projecting. Teeth strong, fang-like on tongue and vomer in front, cardiform on palatines, pterygoids and hyoid, moderate on mandible and small on edge of maxillary. Maxillary reaching hind edge of orbit. Interorbital space a trifle convex. Gill-rakers  $10 + 19$ , slender, longest  $\frac{2}{3}$  of orbit. Scales deciduous. Dorsal inserted about midway in length. Adipose fin about over last third of base of anal. Anal inserted behind tip of depressed dorsal, about midway between origin of ventral and base of caudal. Caudal forked, lower lobe trifle longer. Pectoral about  $\frac{3}{5}$  to ventral. Ventral inserted opposite

insertion of dorsal and reaching  $\frac{2}{3}$  to anal. Color transparent greenish above, sides silvery. Back, dorsal and caudal dusted with pale dusky. Iris silvery. Length  $5\frac{3}{8}$  inches. Raritan River.

This excellent food-fish is found along our coast and sometimes enters the larger rivers. I have it from the Delaware. It attains the length of a foot.

*Osmerus mordax* Abbott, Geol. N. J., 1868, p. 821.—Abbott, Am. Nat., IV, 1870, p. 108, fig. 30.—Abbott, Nat. Rambles, 1885, p. 478.

*Osmerus viridescens* De Kay, N. Y. Fauna, Fish., III, 1842, p. 243.

*Osmerus* sp. Norris, Proc. Acad. Nat. Sci., Phila., 1861, p. 58.

*Osmerus sergenti* Norris, l. c., 1868, p. 93.

### Family SYNODONTIDÆ.

#### The Lizard Fishes.

Body oblong or elongate, little compressed. Sides sometimes with phosphorescent spots or photophores. Mouth very wide, entire margin of upper jaw formed by long slender premaxillaries, closely adherent to which are slender maxillaries, latter mostly rudimental or obsolete and never widened at tip. Teeth mostly cardiform on both jaws, tongue and palatines. Canines rarely present. Large teeth usually depressible. No barbels. Opercular bones usually thin, but complete. Gill-membranes separate, free from isthmus. Gill-rakers tubercular or obsolete. Pseudo-branchiæ present. Branchiostegals usually numerous. Body covered with cycloid scales, rarely naked. Lateral line present. Skeleton rather well ossified. Air-vessel small or wanting. Intestinal canal short. Eggs inclosed in sacs of ovary and extruded through an oviduct. Dorsal fin short, of soft rays only. Adipose fin present, rarely obsolete. Anal moderate or long. Caudal forked. Pectorals and ventrals present.

Mostly shore-fishes, some in great depths and with unknown habits. Not used as food. One genus and species on our shore.



Genus *SYNODUS* Bloch and Schneider.

## The Lizard Fishes.

*Synodus fœtens* (Linnæus).

## PLATE 9.

## Lizard Fish.      Soury.      Frost Fish.

Head 4; depth  $7\frac{1}{2}$ ; D. 11, 11; A. 11, 10; scales 56 in lateral line to base of caudal; 6 scales between dorsal and lateral line; 6 scales between lateral line and ventral; snout  $3\frac{1}{2}$  in head; eye  $6\frac{3}{5}$ ; maxillary  $1\frac{5}{7}$ ; interorbital space  $5\frac{3}{4}$ ; base of dorsal  $2\frac{1}{6}$ ; base of anal  $1\frac{5}{6}$ ; upper caudal lobe  $1\frac{3}{7}$ ; pectoral  $2\frac{1}{8}$ ; ventral  $1\frac{1}{4}$ ; least depth of caudal peduncle  $4\frac{1}{4}$ . Body slender, cylindrical, tapering posteriorly. Head attenuate, depressed. Snout pointed, depressed, protruding beyond mandible. Eye circular, anterior and encroaching a little on profile above. Mouth wide. Premaxillaries not protractile, with 2 series of knife-shaped compressed large teeth, inner depressible. Patch of strong depressible teeth on tongue anteriorly, and a long row along hyoid bone. Interorbital space broad and concave. Gill-rakers minute. Rows of scales rather irregular and moderately oblique. Cheek with 7 rows, 26 before dorsal, and 5 between adipose fin and lateral line. Dorsal inserted nearer tip of snout than base of caudal. Adipose fin inserted midway between tip of depressed dorsal and base of caudal. Anal inserted a little nearer tip of ventral than base of caudal. Caudal deeply forked, lobes pointed sharply. Least depth of caudal peduncle a trifle more than half its length. Pectoral short, rounded, about  $\frac{4}{5}$  of space to ventral or about midway between tip of snout and origin of anal. Color sandy-gray, pale yellowish below. Back mottled, and head above vermiculated. Ventrals, inside and lower side of mouth, tinged yellowish. Fins otherwise pale grayish. Length  $7\frac{1}{2}$  inches. Atlantic City.

A slender species with saurian aspect darting about on sandy shoals which has earned the name lizard fish. At the above

locality and at Beesley's Point it is abundant. It will take the hook baited with flesh. Reaches a length of one foot and is not used as a food-fish.

*Synodus fatens* Abbott, Geol. N. J., 1868, p. 821.—Bean, Bull. U. S. F. Com., VII, 1887, p. 148.—Moore, Bull. U. S. F. Com., XII, 1892, p. 359.

*Saurus mexicanus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 346.

## Order APODES.

### The Eels.

#### *Key to the families.*

*a. (Enchelycephali.)* Gill-openings well developed, leading to large inter-branchial slits; tongue present; opercles and branchial bones well developed.

*b.* Scales linear, arranged in small groups and placed obliquely at right angles to those of neighboring groups, rudimentary and imbedded.

ANGUILLIDÆ

*bb.* Scales wholly wanting.

LEPTOCEPHALIDÆ

*aa. (Colocephali.)* Gill-openings small, roundish, leading to restricted inter-branchial slits; tongue wanting; opercles feebly developed.

MURENIDÆ

## Family ANGUILLIDÆ.

### The Eels.

Body elongate. Head conic. Maxillaries lateral. Teeth cardi-form. Tongue distinct. A well-developed opercular apparatus. Lateral branchial apertures vertical. Branchial skeleton nearly perfect. Skin scaly. Vertical fins continuous with dorsal far from head. Pectorals well developed.

The single genus of living forms distributed widely in tropical and temperate waters. They freely ascend all our fresh-waters and descend to the sea for the purpose of reproduction. In the latter they depart from the usual type in true fishes in the concealed generation and development of minute ova. A single species in most all our waters.

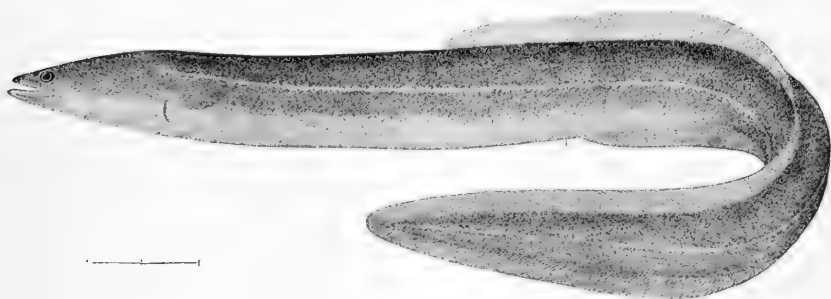
## Genus ANGUILLA Shaw.

## The Eels.

*Anguilla chrisypa* Rafinesque.

## Eel. Bull Headed Eel.

Head  $7\frac{1}{2}$ ; depth  $14\frac{2}{3}$ ; snout  $5\frac{1}{8}$  in head; eye  $9\frac{3}{4}$ ; mouth  $3\frac{2}{3}$ ; interorbital space  $7\frac{1}{2}$ ; pectoral  $3\frac{1}{5}$ ; space between origins of dorsal and anal  $1\frac{1}{8}$ . Body rather robust, elongate, and compressed behind. Head conic, long, moderately pointed. Eye

Eel. *Anguilla chrisypa* Rafinesque.

small, well forward over angle of mouth. Lower jaw protruding. Teeth small, subequal, in bands in jaws and long patch on vomer. Tongue free at tip. Lips rather full, margin free behind and attached by frenum in front. Nostrils superior, well separated, and anterior with slight tube. Gill-openings small, about as wide as base of pectoral and just below in front. Scales imbedded, linear and placed obliquely, some at right angles to others. Lateral line complete. Dorsal inserted near first third in length. Pectoral broad, upper margin straight. Brown, pale below. Length 19 inches. Anglesea.

Abundant at all seasons of the year. The largest example which came under my notice was taken many years ago, which roughly estimated, measured about 4 feet, though it is not alto-

gether exceptional to meet with examples of 3 feet. They usually average, however, about 2 or  $2\frac{1}{2}$  feet. Of all fishes this is one of the most despised by the angler on account of its habit of twisting the line into a mass of tangles and knots in its contortions when drawn from the water. In the Delaware I have seen thousands of small eels during July and August wriggling along the mud and flats as the tide ebbed out. They were about 3 inches in length. Some examples differ much in color, as I have frequently taken individuals of a bright brassy color on the lower surface of the body. The eel is a foul feeder. I have seen an old carcass of a horse which was entirely submerged at high tide furnishing a most welcome repast to hundreds of these animals. When the tide receded they would still crowd in the shallow water and the rippling formed by their continued movements, together with their biting at the decomposed flesh, formed a loud noise. The carcass laid there for several days before the greater part of it was devoured and I never saw one about it during the day. I have also seen them about the mouths of sewers. At Cape May it is the object of considerable commercial enterprise. Not less than 18 to 20 tons were shipped alive to New York and Boston during the year 1903. They are captured by most clammers as soon as the ice drives them into the mud. They generally burrow 6 or 8 inches down, sometimes a little further, and after they become more or less quiet or dormant are speared. The burrows are small holes which seem to be in certain localities having bottoms of a nature these animals prefer. I have not ascertained whether they lie coiled or stretched out. They appear to remain concealed according to temperature and never burrow in warm weather. Those intended for market use are taken in pots about 2 feet long and 10 inches in diameter. One end of the pot is furnished with a funnel opposite to the end of which is a hinged cap to enable one to remove the contents. The bait used is chopped king crabs placed at the far end of the funnel. The crabs are caught in May and June and kept in live pens in the water or until the ice kills them. The pots are placed on bottoms, where they can always hold their contents alive, some being buoyed,

while others may be tied to the shore. They are always placed in salt-water creeks and in tide-water. The eels are shipped in ordinary closed freight cars and when packed alive in boxes will live at least 48 hours with the only danger in freezing. Many years ago eels were very abundant about the cancerine (king crab) factory, where they fed on refuse, especially maggots. They are also common in the mouth of the bay and in the breakwater. In the tide-water of the Great Egg Harbor River many young, of but several inches in length, were seen swimming about among schools of *Fundulus*. Most all were transparent. At the dam at May's Landing numbers of them were found squirming about as though they wished to ascend above the tide-water. In the Delaware thousands of such small eels are to be found during July and August wiggling about the mud-flats. The usual method on the Delaware to fish for eels is by bobbing, and they are sometimes hauled into the boat as fast as one is able to cast.

*Anguilla chrysypa* Moore, Bull. U. S. F. Com., XII, 1892, p. 360.—Smith, Bull. U. S. F. Com., XII, 1892, p. 369.—Evermann, Recreation, April, 1902, p. 292.

*Anguilla tenuirostris* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 350.—Abbott, Geol. N. J., 1868, p. 825.—Abbott, Am. Nat. IV, 1870, p. 391.

*Anguilla macrocephala* Abbott, Geol. N. J., 1868, p. 826.

*Anguilla acutirostris* Abbott, Rep. U. S. F. Com., 1875-76, p. 827.

*Anguilla vulgaris* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 119.

*Anguilla rostrata* Cope, Proc. Acad. Nat. Sci., Phila., 1883, p. 132.—Abbott, Nat. Rambles, 1885, p. 479.—Bean, Bull. U. S. Fish Com., VII, 1887, p. 151.

*Anguilla rostra* Lockwood, Am. Nat., XIX, 1885, p. 405.

### Family LEPTOCEPHALIDÆ.

#### The Conger Eels.

Body moderately elongate. Tongue free, largely in front. Posterior nostril remote from upper lip and near front of eye.

Body scaleless. End of tail surrounded by a fin. Pectoral fins well developed. Plainly colored grayish or dusky above, silvery below and dorsal black-edged.

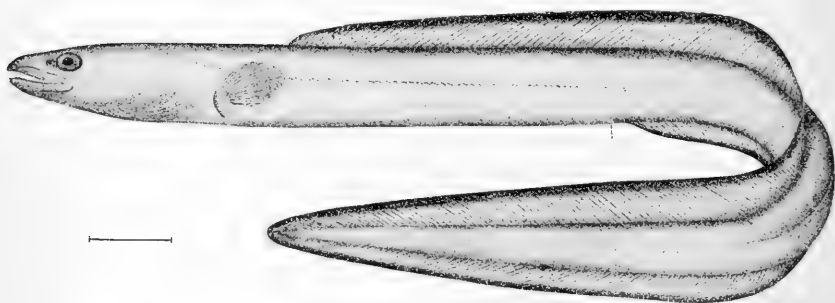
Large marine eels found in most warm seas, usually at moderate depths. Many of the species undergo a metamorphosis, the young being loosely organized and transparent, band-shaped, and with very small head. The body grows smaller with increased age, owing to the compacting of the tissues. A single species on our coast belonging to the typical genus *Leptocephalus*.

### Genus *LEPTOCEPHALUS* Scopoli.

#### The Conger Eels.

*Leptocephalus conger* (Linnæus).

Conger. Conger Eel. Sea Eel.



Conger. *Leptocephalus conger* (Linnæus).

Head  $6\frac{9}{10}$ ; depth  $18\frac{1}{2}$ ; snout  $4\frac{1}{2}$  in head; eye 7; mouth 3; interorbital space 7; pectoral 3; space between origins of dorsal and anal nearly equals head  $1\frac{1}{2}$  times. Body long, slender, a little deeper or heavy forward and long tail tapering back. Head depressed above and anteriorly pointed. Snout rather depressed and produced beyond mandible. Eye elongate, rather large, about first third in head. Mouth wide, extending to below middle of eye. Teeth in outer series of each jaw equal and close-set, forming a cutting-edge. Band of vomerine teeth short. Tongue free in front. Lips rather broad and fleshy laterally.

Posterior nostril near eye, anterior near tip of snout with short tube. Gill-opening rather large, low. Dorsal inserted about first fifth in length of body. Color brown, paler below. Confluent dorsal, caudal and anal pale brown with a narrow black margin. Pectoral pale brown. Length  $11\frac{1}{8}$  inches. Atlantic City.

I have but 2 small examples from the above locality. It is said to reach a length of 8 feet and be a food-fish of importance. A large example is in the Wistar Institute of Anatomy in Philadelphia received from Sea Isle City. Dr. Dahlgren reports 2 or 3, about 6 feet long, taken with tautog-bait on rocky bottom off Avon.

*Conger conger* Bean, Bull. U. S. F. Com., 1887, p. 150.—Smith, Bull. U. S. F. Com. XII, 1892, p. 369.

*Conger occidentalis* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 351.—Abbott, Geol. N. J., 1868, p. 825.

*Isognatha oceanica* Abbot, l. c.

### Family MURÆNIDÆ.

#### The Morays.

Head conic. Jaws usually narrow and armed with knife-like, or else molar, teeth. Occipital region elevated through development of muscles moving lower jaw. Opercular apparatus fully developed. Branchial apertures lateral, small and round. Ethmoid bone long and wide. Interbranchial slits restricted. Branchial skeleton very imperfect, and fourth branchial arch modified, strengthened and supporting pharyngeal jaws. Body and fins covered with a thick leathery scaleless skin. Diversified vertical fins. Pectoral normally absent.

Morays inhabit tropical and subtropical waters, especially in the rocks about coral reefs. Many are very voracious and pugnacious. They reach a large size and are strikingly colored. The form here recorded, evidently a waif from tropical waters in the Gulf Stream.

## Genus GYMNOTHORAX Bloch.

## The Tropical Morays.

*Gymnothorax ocellatus* Agassiz.

## PLATE 10.

Head  $6\frac{2}{3}$ ; depth  $15\frac{3}{4}$ ; snout 5 in head; eye  $7\frac{1}{2}$ ; mouth  $2\frac{1}{2}$ ; interorbital space 6; head and trunk a trifle less than tail. Body deep, well compressed and tapering back from pharynx, which is greatest depth. Head compressed, and muzzle a little elongate, blunt. Snout convex, a little long. Eye about midway in length of mouth, and ellipsoid. Jaws even and along margin of each a single series of large knife-like entire backwardly-directed triangular teeth. In front of mouth about 2 depressible similar teeth. Mouth not completely closing, so that some teeth are visible. Anterior nostril in a fleshy tube near tip of snout. Posterior nostril a conspicuous pore over front rim of pupil in interorbital space. Interorbital space convex. Gill-opening about  $\frac{4}{7}$  of horizontal orbital diameter. Along edge of upper jaw anteriorly 3 pores on each side, and same on mandible. Several longitudinal striæ along each side of pharynx, which is also finely wrinkled. Dorsal beginning about last fourth in space between posterior margin of eye and gill-opening. Confluent fins low, and caudal small. Color in alcohol pale brownish, body everywhere marked by a reticulating pattern leaving small rounded pale spots. On tail posteriorly these become large and more irregular. Same pattern of coloration extends over basal portion of caudal to its margin, which is marked by about 25 elongate irregular deep brown blotches with ocellated margins, pale encircling color sometimes nearly white. Margin of anal uniform deep brown. Head uniform pale brownish. Iris slaty. Length  $14\frac{1}{8}$  inches. New Jersey. Capt. Davis. No. 995, Academy of Natural Sciences of Philadelphia.

Known from our coast only by the above example, most likely a straggler from tropical America in the Gulf Stream. It agrees very well with one from San Domingo however. The *Gymno-*



*thorax occlatus* of Agassiz was based on a Brazilian fish, a form which I have not seen, but which differs according to the original figure in the more sparse and enlarged dark blotches.

## Order EVENTOGNATHI.

### The Carp Like Fishes.

This group includes the majority of fresh-water fishes of the world.

#### *Key to the families.*

- a. Pharyngeal teeth few; margin of upper jaw formed by premaxillaries alone. CYPRINIDÆ
- aa. Pharyngeal teeth many, pectinate; maxillaries forming part of margin of upper jaw. CATOSTOMATIDÆ

### Family CYPRINIDÆ.

#### The Carps.

Body of various form. Belly usually rounded, rarely compressed and never serrated. Margin of upper jaw formed by premaxillaries alone. Barbels 2 or 4, absent in most of our genera and not large in any. Gill-openings moderate, membranes broadly joined to isthmus. Gills 4, slit behind fourth. Pseudo-branchiæ usually present. Branchiostegals 3. Lower pharyngeal bones well developed, falciform, nearly parallel with gill-arches, each provided with 1 to 3 series of teeth in small number, 4 to 7 in main row and less number in others if more are present. Air-vessel usually large, commonly divided into an anterior and a posterior lobe, not inclosed in a bony capsule, and rarely wanting. Stomach without appendages, appearing as a simple enlargement of the intestines. Head naked. Body mostly scaly. Dorsal fin short in our species, elongate in those of the Old World. Ventral fins abdominal.

Fresh-water fishes of moderate or small size of the Old World and North America. Where found they are excessively abundant both in species and individuals and from their great uniformity in size, form and coloration constituting one of the

most difficult groups in natural history in which to distinguish genera and species. Our genera are mostly very closely related and are separated by characters which, although reasonably constant, are often of slight structural importance. The spring or breeding dress of the male fish is often peculiar. The top of the head and often the fins, or various portions of the body, are covered with small tubercles, outgrowths from the epidermis. The fins and lower parts of the body in spring males are often charged with bright pigment, the prevailing color of which is red, although in some genera it is satin white, yellowish or black. The young are usually more slender than the adults of the same species and the eye is always much larger. They also frequently show a black lateral stripe and caudal spot which the adults may not possess. The fins and scales are often, especially in specimens living in small brooks or still pools, covered with small round black specks, immature trematodes. These should not be taken for true color markings. No progress can be made in the study of these fishes without careful attention to the teeth. The pharyngeal teeth of the smaller species may best be hooked out through the gill-opening under the shoulder-girdle. They are very brittle, however, and care should be exercised in their removal, as they easily break off. In most cases a principal row of 4 or 5 larger teeth will be found, in front of which is a set of 1 or 2 smaller ones. The two sides are usually but not always symmetrical.

*Key to the genera.*

- a. CHONDROSTOMATINÆ. Intestinal canal elongate, usually more than twice length of body; teeth 1-rowed with grinding surface well developed; peritoneum usually black; herbivorous.
- b. First rudimentary dorsal ray slender, firmly attached to first developed ray. HYBOGNATHUS
- bb. First rudimentary dorsal ray somewhat enlarged, blunt, and connected by membrane with first developed ray. PIMEPHALES
- ca. LEUCISCINÆ. Intestinal canal short, less than twice length of body; teeth 1 or 2-rowed; peritoneum usually pale; carnivorous or partly so.
- c. Lower jaw normally formed, dentary bones curved, free from each other, except at symphysis.
- d. Teeth in main row 5-5 or 4-5, lesser row sometimes absent.
- e. Postventral region transversely rounded, scales passing over it or its edge not forming a scaleless ridge; anal base generally short.

- f.* Maxillary barbel minute, not quite terminal. SEMOTILUS  
*ff.* Maxillary barbel absent. LEUCISCUS  
*cc.* Postventral region tranchant, scales not passing over its edge;  
 anal basis long. BRAMA  
*dd.* Teeth in main row 4-4, lesser row often absent.  
*g.* No maxillary barbels; upper jaw protractile. NOTROPIS  
*gg.* Maxillary with a small barbel near its tip.  
*h.* Premaxillaries not protractile; teeth 2, 4-4, 2. RHINICHTHYS  
*hh.* Premaxillaries protractile; scales 35 to 55; teeth  
 4-4, or 1, 4-4, 1 or 0, lesser row with never more  
 than 1. HYBOPSIS  
*cc.* EXOGLOSSINÆ. Lower jaw singularly formed, dentary bones parallel,  
 united their whole length. EXOGLOSSUM

## Genus HYBOGNATHUS Agassiz.

## The Gudgeons.

*Hybognathus nuchalis regius* (Girard).

(FRONTISPIECE—PART II.)

## Gudgeon. Silvery Minnow.

Head  $4\frac{1}{2}$ ; depth 4; D. II, 7, 1; A. III, 7, 1; scales 37 in lateral line to base of caudal, 3 more on latter; 6 scales obliquely back from origin of dorsal to lateral line; 4 scales between origin of ventral and lateral line; snout  $3\frac{3}{4}$  in head; eye  $3\frac{1}{4}$ ; maxillary 4; interorbital space  $2\frac{1}{2}$ ; pectoral 1; ventral  $1\frac{1}{4}$ ; least depth of caudal peduncle  $1\frac{5}{6}$ ; pharyngeal teeth 4-4. Body elongate, somewhat compressed and slender. Head rather short, blunt. Snout blunt, protruding a little beyond mandible. Eye small. Maxillary not reaching eye. Interorbital space broad, convex. Gill-rakers few, short, fleshy. Scales large, uniform in size. Lateral line continuous, slightly decurved. Intestines long, more than 7 times length of body. Peritoneum black. Dorsal inserted nearer tip of snout than base of caudal. Anal inserted behind tip of depressed dorsal. Caudal deeply forked, lobes pointed. Pectoral about  $\frac{3}{5}$  of space to ventral. Ventral inserted behind origin of dorsal and reaching about  $\frac{5}{7}$  of space to anal. Color mostly silvery, back pale translucent olive. Fins pale, dorsal and caudal a trifle dusted. Iris silvery. Length  $4\frac{7}{8}$  inches. Trenton.

During May of 1904 the above example, together with many others were taken in woodland affluents of Crosswicks Creek near Trenton by Dr. Abbott and myself. In life they were pale olive-brown above, with somewhat metallic bluish-green along side of back. A brassy-golden tinge from head to base of caudal more or less sprinkled with minute dusky dots, and some showing through bluish-green. Ventral region white, translucent, and with a tinge of straw-color showing through. Side of head brassy-silvery. A median dusky streak on back. Margins of scales not particularly darker though edged with dusky. Dorsal and caudal pale olive-brown, translucent, or paler along margin of latter, especially below. Pectoral same, a little dusky above. Ventral and anal more translucent or dilute amber-color. Iris glassy-silvery, dusky above. Some variation was noticeable. The large ones were altogether more opaque-white below, the sides more distinctly bluish above in some lights, and the reflections of more golden-bronze confined to certain places, as the head. Others had streaks on side of caudal peduncle or tail above anal, with a distinct band of golden showing through distinctly like the band on an anchovy. The young do not differ from the adults in color. They resemble the young of other common minnows but may be identified among any other Delaware species, except the *Pimephales*, by means of the black peritoneum.

A fairly abundant and beautiful minnow in the Delaware and Raritan basins. It was described from the latter as *Hybognathus osmerinus* by Cope, which, however, is not different from *Hybognathus regius* of Girard. It differs from the true *Hybognathus nuchalis* of the Mississippi Valley in its larger size. The type of *H. osmerinus* I have not seen, however, and base the above comparison upon Delaware and Potomac specimens which reach 7 inches. It is less common in the Delaware than *Notropis hudsonius amarus*, with which it is found associated and for which it may easily be mistaken. Few anglers are able to distinguish the two species, and frequently they are called "gudgeon" alike. I have mostly met with this fish during the summer months in the open river. It is then more or less troublesome

at times, snapping at perch lines, though seldom taking the hook. When one is fishing for white perch (*Morone americana*) in clear water these minnows will dart at and snap at the line well above the bait, to the annoyance of the angler. Small river mussels (*Unio complanatus*) are also taken on the hook, as they frequent the same localities.

*Hybognathus regius* Abbott, Proc. Acad. Nat. Sci., Phila., 1861, p. 156.

*Hybognathus nitidus* Abbott, l. c.

*Hybognathus osmerinus* Cope, Proc. Amer. Philos. Soc., Phila., XI, 1870, p. 466.—Abbott, Am. Nat., IV., 1870, p. 117.—Abbott, l. c., p. 717, fig. 163.—Abbott, l. c. VIII, 1874, p. 335.

*Hybognathus argyritis* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 107.

*Hybognathus nuchalis* Abbott, Nat. Rambles, 1885, p. 478.

## Genus PIMEPHALES Rafinesque.

### The Fat Heads.

**Pimephales notatus** (Rafinesque).

### Blunt Nosed Minnow.

From the other minnows this may be distinguished by the blunt and enlarged first rudimentary dorsal ray, which is connected by a membrane with the first developed dorsal ray. The muzzle is also blunt and convex.

Known from a single example taken from the Delaware and Raritan canal by Dr. Abbott and Prof. A. C. Apgar. It was captured with *Hybognathus nuchalis regius*. I have never seen any New Jersey examples.

*Hyborhynchus notatus* Abbott, Am. Nat., VIII, 1874, p. 337.—Abbott, Nat. Rambles, 1885, p. 478, copied.

## Genus SEMOTILUS Rafinesque.

## The Fall Fishes.

*Key to the species.*

- a. Scales large, about 45 in lateral line, and not much crowded anteriorly; dorsal without black spot. BULLARIS
- aa. Scales smaller, 45 to 65 in lateral line, and crowded anteriorly; dorsal with a black spot at base of anterior rays. ATROMACULATUS

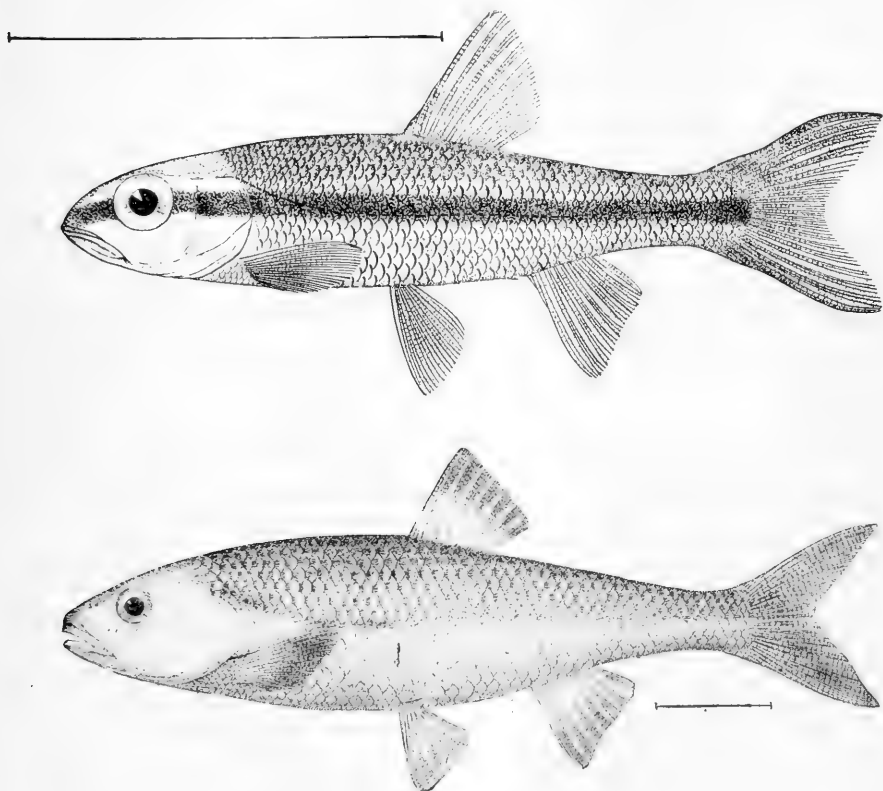
**Semotilus bullaris** (Rafinesque).

## Chub.

Head 4; depth  $3\frac{2}{3}$ ; D. III, 7, 1; A. III, 7, 1; scales 43 in lateral line to base of caudal, 3 more on latter; 8 scales obliquely back from origin of dorsal to lateral line; 5 scales obliquely forward from origin of ventral to lateral line; 20 scales before dorsal; snout 3 in head; eye 5; maxillary 3; interorbital space  $2\frac{4}{5}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{3}{4}$ ; least depth of caudal peduncle  $2\frac{3}{4}$ ; pharyngeal teeth 2, 5—4, 2. Body robust, little compressed. Head large, convex, snout bluntly conic, slightly produced beyond mandible. Eye small, ellipsoid, high. Maxillary not quite reaching front of eye. Small barbel on maxillary, just above its tip, much shorter than pupil. Interorbital space broadly convex. Gill-rakers 3 + 5 short weak denticles. Scales large, striate, not crowded in front of dorsal. Lateral line decurved. Dorsal inserted nearer base of caudal than tip of snout. Anal inserted nearer origin of ventral than base of caudal. Caudal forked. Pectoral reaching  $\frac{2}{3}$  of space to ventral. Ventral before dorsal and reaching nearly  $\frac{2}{3}$  of space to anal. Ground-color pure silver-white. Back steel-blue. Cheeks bright rosy. Sides with rosy. Dorsal and pectoral fins with crimson. Length  $10\frac{1}{2}$  inches. Trenton. Type of *Leucosomus rhotheus* Cope.

A vigorous active fish reaching a length of 18 inches. It is often found about rapids and falls, from which it has earned the name fall fish. The large ones occur in rivers or other large bodies of fresh-water. Those most likely to be met with

are in the smaller streams of clear water, not very deep, and with good protection of vegetation along the banks. A stream which may be easily waded, and with here and there a deep pool into which the fish may dart when disturbed are the most favored. In such places they are the delight of the small boy. The usual method is to select a short pole with a line of moderate or



Chub. *Semotilus bullaris* (Rafinesque). (Upper figure young, lower adult.)

short length, and only a hook. The sinker and float are not much in vogue. The bait usually employed is a large fat white grub dug out of an old stump of decayed wood. At least this is found successful in the majority of cases. The fish are always shy, and it is necessary to remain very quiet while angling, and also seek the best concealment possible. The instant the bait touches the water the fish dart at it. The young appear to be

less common than those of *Semotilus atromaculatus*. Many which I examined lack the barbel, especially the very young. They may be easily distinguished by their round or robust bodies and large scales. Young of about  $1\frac{1}{2}$  inches show a dusky band from the eye to the base of the caudal, though there is no distinct black spot at the base of the latter. When about 3 inches or over in length the dusky lateral band is seen to become diffuse, and more or less fades out altogether as the fish increase in size. When taken from the water the chub sometimes makes a squeaking noise more like a voice than any produced by our other fresh-water fishes. The food consists of insects, frequently apple bugs (*Gyrinidæ*). Dr. Bean very rightly contends that the preliminary diagnosis of *Cyprinus corporalis* of Mitchill is insufficient. I therefore follow him in adopting *Cyprinus bullaris* of Rafinesque.

*Semotilus bullaris* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 108.—Abbott, Nat. Rambles, 1885, p. 479.

*Semotilus corporalis* Abbott, Proc. Acad. Nat. Sci., Phila., 1861, p. 154.—E. Smith, Proc. Lin. Soc., N. Y., IX, 1897, p. 27.

*Leucosomus rhotheus* Cope, Proc. Acad. Nat. Sci., Phila., 1861, p. 523, based on Abbott.

*Semotilus rhotheus* Cope, Trans. Amer. Philos. Soc., Phila., XIII, 1869, p. 362, Pl. 10, fig. 1.—Abbott, Geol. N. J., 1868 (1869), p. 823.—Abbott, Am. Nat. IV, 1870, pp. 100, 110, 116, fig. 32.—Abbott, l. c., p. 385.—Abbott, l. c. VIII, 1874, p. 327.—Abbott, Rep. U. S. F. Com., 1875-76, p. 840.

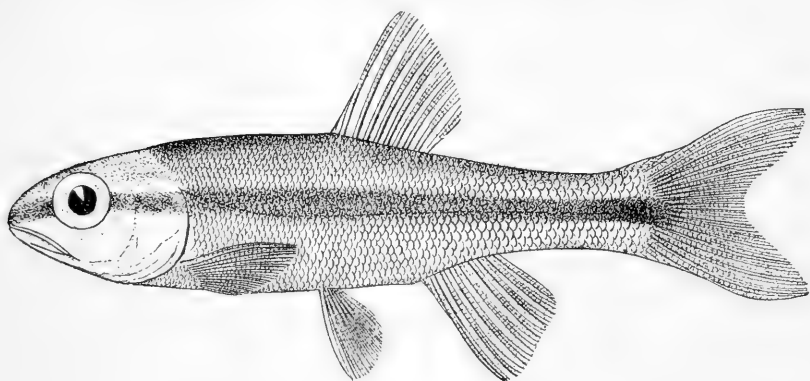
***Semotilus atromaculatus* (Mitchill).**

Chub.

Head  $3\frac{1}{3}$ ; depth  $4\frac{2}{3}$ ; D. II, 7; A. III, 7; scales 55 in lateral line to base of caudal, 3 more on latter; 11 scales obliquely back from origin of dorsal to lateral line; 6 scales between origin of anal obliquely forward to lateral line; snout  $3\frac{1}{5}$  in head; eye  $5\frac{2}{3}$ ; maxillary  $2\frac{4}{5}$ ; interorbital space  $2\frac{3}{4}$ ; pectoral  $1\frac{3}{5}$ ; ventral  $1\frac{4}{5}$ ; pharyngeal teeth 2, 5—4, 2. Body stout. Profile of pre-



dorsal region convex, so that body tapers backwards from a point considerably in advance of dorsal with base of that fin oblique. Head large and heavy, broad and rounded above. Snout broad, a little protruding. Eye small. Mouth oblique, broad. Upper lip just below level of pupil. Maxillary barely reaching front of orbit. Maxillary barbel small. Interorbital space broad and a little convex. Gill-rakers  $4 + 5$  short points. Scales small, considerably crowded and reduced anteriorly, about 30 before dorsal. Lateral line decurved. Fins small, dorsal inserted about midway between posterior margin of eye and base of caudal. Anal inserted a little nearer origin of ventral than base of caudal. Caudal forked. Pectoral reaching  $\frac{2}{3}$  of space to ven-



Chub. *Semotilus atromaculatus* (Mitchill). (Young.)

tral. Ventral well before dorsal and reaching  $\frac{2}{3}$  of space to anal. Color dusky-bluish above. Side with a dull dusky band disappearing with age. Belly creamy. A dusky bar behind opercle. Edges of scales with dusky dots. A black blotch at base of dorsal in front. Length  $5\frac{1}{4}$  inches. "Beesley's Point" [probably Cedar Swamp Creek?].

Abundant, chiefly in small brooks. It is found in the same localities as the preceding. In most all small upland brooks the young abound, associated with other small minnows, from which they are distinguished by the crowded scales before the dorsal fin and the more robust body. They are abundant throughout the Delaware basin. Spring males have the dorsal blotch bordered

with red, belly rosy tinted and snout coarsely tuberculate. Young with lateral dusky band black and base of caudal with black spot. I have examples from Trenton.

*Semotilus atromaculatus* Abbott, Proc. Acad. Nat. Sci., Phila., 1861, p. 156.

*Semotilus corporalis* Cope, Trans. Amer. Philos. Soc., Phila., XIII, 1869, p. 363, Pl. 10, fig. 2.—Abbott, Geol. N. J., 1868 (1869), p. 824.—Abbott, Am. Nat., IV, 1870, pp. 100, 110.—Abbott, l. c., VIII, 1874, p. 327.—Jordan, An. N. Y. Acad. Sci., I, 1879, p. 107.—Abbott, Nat. Rambles, 1885, p. 478.

### Genus LEUCISCUS Cuvier.

#### The Dace.

#### *Key to the species.*

- a. Lateral line complete; body oblong, deep and compressed. VANDOISULUS
- aa. Lateral line incomplete, pores usually ceasing behind middle of body;  
body stout, thick, little compressed, and back somewhat elevated.

MARGARITA

#### *Leuciscus vandoisulus* Valenciennes.

#### Rosy Dace. Pike Shiner.

Related to the chub and roach, it differs in the same respects from the other *Leuciscinae* in the presence of at least 5 teeth in the larger pharyngeal series. From the chub it differs in the absence of a maxillary barbel at all ages, and from the roach in having the postventral region rounded, that fish having it compressed to a sharp keel over which the scales do not pass. It has a wide mouth and small scales, and the males are brilliantly colored with red pigment during the breeding-season.

I have not seen examples from the Delaware among the multitudes of cyprinoids which I have examined from its various affluents. The examples Dr. Abbott records were stated by that gentleman to have been sent to Cope and by the latter to have been determined as *Clinostomus funduloides*. They were taken in the main channel of the river at Trenton.

*Clinostomus funduloides* Cope, Trans. Amer. Philos. Soc., Phila., XIII, 1869, p. 376, Pl. 13, fig. 21.—Abbott, Geol. N. J., 1868 (1869), p. 824.—Abbott, Am. Nat., VIII, 1874, p. 331.

*Squalius funduloides* Abbott, Nat. Rambles, 1885, p. 479.

**Leuciscus margarita** (Cope).

The Gold Thread Shiner.

This species may be distinguished from the preceding by the incomplete lateral line, the pores usually ceasing after the middle of the body.

This species is known from the Delaware basin, where the Assanpink enters it, according to Dr. Abbott, by several specimens associated with *Leuciscus vandoisulus*. They were determined by Cope himself Dr. Abbott assures me.

*Clinostomus margarita* Abbott, Geol. N. J., 1868 (1869), p. 824.

Genus **BRAMA** Walbaum.

(Type *Cyprinus brama* Linnæus.)

The Breams.

*Key to the species.*

a. Pectorals, ventrals and anal yellowish.

**CRYSOLEUCAS**

aa. Pectorals, ventrals and anal tinted crimson.

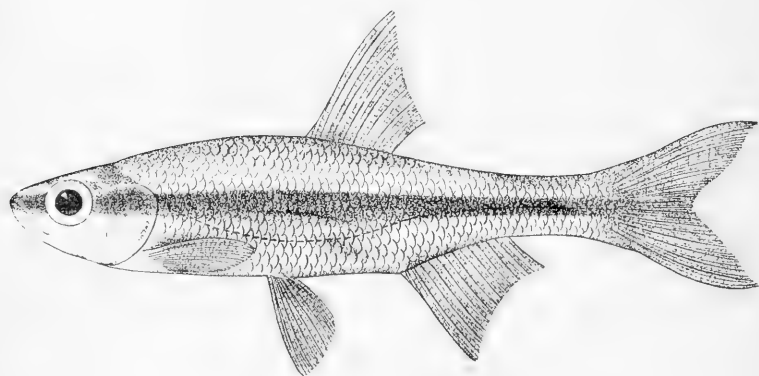
**CRYSOLEUCAS VERSICOLOR**

**Brama crysoleucas** (Mitchill).

Shiner. Roach. Gudgeon. Young Shad. Dace. Wind Fish.

Head  $4\frac{3}{5}$ ; depth 3; D. II, 7; A. III, 12; scales 47 in lateral line to base of caudal, 3 more on latter; 11 scales between origin of dorsal and lateral line; 3 scales between lateral line and origin of anal; pectoral  $1\frac{1}{5}$  in head; ventral  $1\frac{1}{3}$ ; least depth of caudal peduncle  $2\frac{1}{15}$ ; fourth anal ray  $1\frac{1}{3}$ ; snout  $3\frac{3}{5}$  in head measured from tip of snout; eye  $3\frac{1}{2}$ ; maxillary  $3\frac{1}{2}$ ; interorbital space

$2\frac{1}{2}$ ; pharyngeal teeth 5-5. Body subelliptical, strongly compressed, and lower profile well convex. Head short, subconic, and lower profile more inclined. Snout short, broadly convex. Eye large. Mouth oblique, small, upper lip level with upper part of pupil. Maxillary not reaching eye. Interorbital space broadly convex. Gill-rakers  $5 + 16$ , slender, and longest nearly equals diameter of pupil. Lateral line strongly decurved. Dorsal inserted nearer base of caudal than posterior margin of eye. Caudal deeply forked. Anal begins just behind base of dorsal, and anterior rays elevated. Pectoral reaching  $\frac{2}{3}$  of space to ventral. Ventral inserted well before dorsal or about midway between



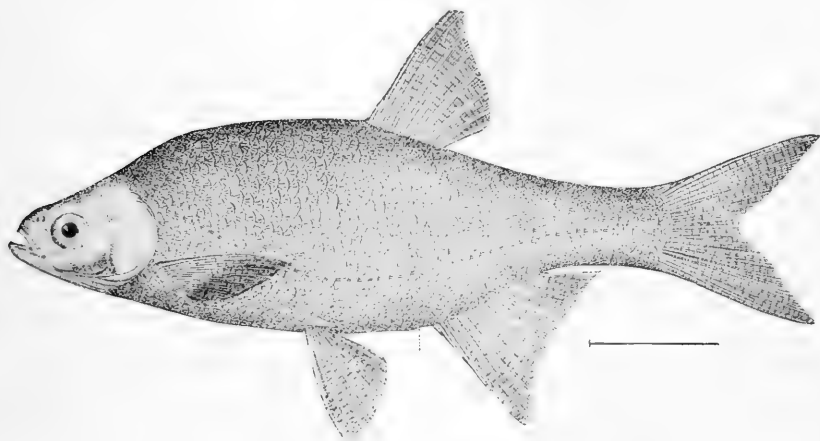
Roach. *Brama crysoleucas* (Mitchill). (Young.)

origins of pectoral and anal, and reaching about  $\frac{2}{3}$  of space of latter. Clear greenish on back, sides and lower parts silvery with golden tints on former. Fins yellow, dorsal and caudal tinted a little pale dusky. Length 7 inches. Morris County.

In life the adult is olivaceous-brown with metallic blue or bottle-green reflections, this color not extending below middle or orbit on side where there is a beautiful coppery longitudinal streak from eye till along upper side of caudal peduncle posteriorly. Jaws brownish. Lower surface white with silvery and brassy reflections, all however with a slight yellowish sheen in certain lights. Dorsal and caudal dull brownish-olivaceous, basally with

rather dark golden-saffron tinge. Anal yellowish-brown. Pectoral and ventral yellow. Inside of gill-opening with purplish reflections. Iris yellowish-white, above greenish. Trenton.

Our most abundant minnow and found alike in small brooks, ponds, pools, and the deeper waters of the Delaware River. In the upland streams the young are most frequently met with. They associate in large schools, often in the shallows of the more sluggish or still waters. In such places, apparently protected from more formidable enemies and at the same time finding an abundance of food supplies, they swim slowly about. Frequently they turn, suddenly exposing a gleaming silvery side to the sun-



Roach. *Brama crysoleucas* (Mitchill). (Adult.)

light which has earned for them the appropriate name of "shiner." I have found them associated with most all of our common fishes. Sometimes they reach a length of nearly a foot, when they are thought by some to be the young of the shad, a fish with which they have some superficial resemblance. These larger ones are frequently taken with ordinary earth-worms on hooks by youthful anglers. They make a good pan-fish, but are usually too small to be of any importance.

*Notemigonus chrysoleucas* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 114.—Abbott, Nat. Rambles, 1885, p. 179.

*Abramis crysoleucas* Evermann, Recreation, April, 1902, p. 292.

*Leucosomus americanus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 341.

*Luxilus americanus* Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 156.

*Stilbe americana* Cope, Trans. Am. Philos. Soc. Phila., XIII, 1869, p. 389, fig. (teeth).—Abbott, Geol. N. J., 1868 (1869), p. 825.—Abbott, Amer. Nat., IV, 1860, pp. 100, 112.—Abbott, l. c. VIII, 1874, p. 328.—Abbott, Rep. U. S. F. Com., 1875-76, p. 841.

***Brama crysoleucas versicolor* (De Kay).**

Mouth when closed, on a line drawn through pupil. Scales with 7 to 12 striæ. Dorsal depressed, reaching point opposite ninth anal ray. Ventral depressed reaches pointed separated 2 scales from vent. Ventral fins crimson on anterior rays, fading into orange. Other fins lemon-yellow with black lines on caudal and dorsal. Length  $7\frac{1}{2}$  inches. Delaware River. (Abbott.)

Provisionally this may be retained. It is evidently close to the common roach and apparently best distinguished by the crimson ventrals. Perhaps it is identical with *Abramis chrysoleucas roseus* Bean,<sup>1</sup> from New York City.

**Genus NOTROPIS Rafinesque.**

**The Shiners.**

*Key to the species.*

- a. Teeth 4-4, 1, 4-4, 0 or 1, 4-4, 1, sometimes 2 teeth in 1 or both inner rows in *N. hudsonius amarus*.
- b. Scales not closely imbricated, not notably deeper than long.
  - c. Teeth one-rowed, 4-4, the grinding surface more or less developed at least on 1 or 2 teeth.
    - d. Lateral line usually more or less incomplete; chin black; dark lateral band. BIFRENATUS
    - dd. Lateral line complete; chin pale; no caudal spot; pale lateral band; caudal peduncle slender. PROCNE
  - cc. Teeth two-rowed 1, 4-4, 1 or 1, 4-4, 1 or 2, the grinding surface more or less developed. HUDSONIUS AMARUS
- bb. Scales deeper than long, more or less closely imbricated along sides of body, teeth 1, 4-4, 1; dorsal with a large black blotch on its upper posterior rays. ANALOSTANUS

<sup>1</sup> Bull. N. Y. State Mus., IX., Zool. 9, 1903, p. 132.

aa. Teeth 2, 4-4, 2.

c. Anal 7 to 9.

f. Exposed surfaces of costal scales very narrow; dorsal over ventrals; no black caudal spot. CORNUTUS

ff. Costal scales not narrowly imbricated; dorsal inserted behind ventrals; a very dark lateral band ending in a black caudal spot.

g. Body rather pale; lower surface of caudal peduncle pale.

CHALYBÆUS

gg. Body deeply colored, dark; lower surface of caudal peduncle dusky.

CHALYBÆUS ABBOTTI

ce. Anal 11 to 12, inserted behind ventrals; scales on side not imbricated.

AMÆNUS

### **Notropis bifrenatus (Cope).**

#### PLATE II.

#### Bridled Minnow. Minnie.

Head  $4\frac{1}{8}$ ; depth 4; D. 11, 7; A. 11, 6; scales 35 in lateral series to base of caudal, 9 in lateral line; 12 scales before dorsal; 10 scales in an oblique series back from origin of dorsal; snout  $3\frac{3}{4}$  in head; eye 3; maxillary 4; interorbital space  $2\frac{1}{4}$ ; length of depressed dorsal 1; of depressed anal  $1\frac{1}{6}$ ; least depth of caudal peduncle  $2\frac{1}{8}$ ; pectoral  $1\frac{2}{5}$ ; ventral  $1\frac{2}{5}$ ; pharyngeal teeth 4-4. Body rather slender, compressed, fusiform. Caudal peduncle long, its least depth about  $2\frac{1}{3}$  in its length, and compressed. Head rather convex above, and of moderate size. Snout and muzzle rather obtuse. Eye circular, anterior, rather large. Mouth a little oblique, small, and mandible inferior or included. Maxillary short, not reaching orbit. Nostrils conspicuous, superior, near eye. Interorbital space broad and convex. Gill-rakers  $2 + 5$  rudimentary weak denticles. Scales of more or less uniform size or with uniform exposed surfaces not narrowly imbricated. Lateral line barely extending to dorsal, of simple tubes, and sloping down a little. Origin of dorsal much nearer tip of snout than base of caudal, and depressed fin much less than half of space to latter. Anal inserted a little behind base of last dorsal ray, and reaching half way to base of caudal. Caudal forked, longer than head, and lobes rather rounded. Pectoral low and

reaching two-thirds of space to ventral. Origin of ventral opposite that of dorsal, and depressed fin reaching anal. Color straw-brown, scales on back edged with brown. A shining dusky or dusky-leadened band around snout, including tip of mandible, and through eye to base of caudal, where it ends in a black spot. On snout a pale brown shade adjoining black band above. Side and lower surface of body with silvery reflections. Fins pale or dilute brownish, dorsal and caudal a trifle darker. Length  $1\frac{5}{8}$  inches. Crosswicks Creek near Trenton in May, 1904.

This minnow is found locally abundant. They are generally seen in the smaller creeks and seem to prefer rather still deep water with a gentle current. I have never taken them in the main channel of the Delaware River, though of course they may occur there. The young do not differ much from the adult, as they have the pronounced black longitudinal band. When preserved a long time in alcohol I notice that the black band of most examples fades to a dark plumbeous. Others vary a great deal in regard to the lateral line, as in some it is nearly complete. It does not seem possible to me as yet to separate the fry from those of *procne*, or those which would appear to be the young of the latter. They are abundant in Crosswicks Creek and in the Passaic River.

*Hybopsis bifrenatus* Abbott, Geol. N. J., 1868, p. 825.—Abbott, Am. Nat., VIII, 1874, p. 331.—Abbott, Rep. U. S. F. Com., 1875-76, p. 834.

*Hemitremia bifrenata* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 113.—Abbott, Nat. Rambles, 1885, p. 479.

***Notropis procne* (Cope).**

PLATE 12.

Minnow. Minnie. Swallow Minnow.

Close to *Notropis bifrenatus* but distinguished chiefly by its long caudal peduncle and tail, large brown-edged dorsal scales, and the plumbeous lateral band.

I have no New Jersey examples.

*Hybopsis procne* Cope, Trans. Amer. Philos. Soc. Phila., XIII, 1869, p. 385, Pl. II, fig. 2.—Abbott, Geol. N. J., 1868 (1869),



p. 824.—Abbott, Am. Nat. VIII, 1874, p. 331.—Abbott, Rep. U. S. F. Com., 1875-76, p. 824.

*Cliola procne* Abbott, Nat. Rambles, 1885, p. 478.

***Notropis hudsonius amarus* (Girard).**

Gudgeon. Spawn Eater. Smelt Shiner. Silvery Minnow.  
Blue Lined Minnow.

Head  $5\frac{1}{2}$ ; depth  $4\frac{1}{2}$ ; D. II, 7, 1; A. IV, 7, 1; scales 36 in lateral line to base of caudal, and 2 more on latter; 6 scales obliquely back from origin of dorsal to lateral line; 4 scales between origin of anal and lateral line; 14 scales before dorsal; snout  $3\frac{2}{5}$  in head; eye  $2\frac{4}{5}$ ; maxillary  $3\frac{2}{5}$ ; interorbital space 3; first branched dorsal ray  $1\frac{1}{10}$ ; first branched anal ray  $1\frac{2}{5}$ ; least depth of caudal peduncle  $2\frac{1}{8}$ ; pectoral  $1\frac{1}{6}$ ; ventral  $1\frac{1}{4}$ ; pharyngeal teeth 1, 4-4, 0. Body elongate, compressed, and rather slender. Caudal peduncle compressed, rather long. Head short, with blunt rounded convex muzzle. Snout projecting a little beyond tip of mandible. Eye longer than snout, also a little longer than deep, and its center a little anterior. Mouth inferior, a little oblique, with small maxillary nearly reaching eye. Nostrils large, close together, near front of eye above. Interorbital space broad and but slightly convex. Preorbital about two-thirds of horizontal orbital diameter. Gill-rakers 2 + 4 short weak denticles. Scales large, rounded, well striate, and of uniform size. Lateral line median, continuous, and of simple tubes. Origin of dorsal midway between tip of snout and base of caudal. Anal inserted about opposite tip of depressed dorsal. Caudal emarginate. Pectoral reaching two-thirds of space to ventral. Ventral inserted opposite origin of dorsal, and reaching about five-sixths of space to anal. Color pale olivaceous. Sides silvery. Base of caudal pale like caudal fin, without blotch. Length  $4\frac{1}{4}$  inches. Trenton.

*Hybopsis phanna* Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 279.—Abbott, Am. Nat. VIII, 1874, p. 333.

*Hybopsis hudsonius* Cope, Trans. Amer. Philos. Soc. Phila., XIII, 1869, p. 386, Pl. 12, fig. 3.—Abbott, Geol. N. J., 1868

(1869), p. 825.—Abbott, Am. Nat., IV, 1870, p. 718.—Abbott, l. c., VIII, 1874, p. 332.

*Alburnops hudsonius* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 109.

*Cliola hudsonia* Abbott, Nat. Rambles, 1885, p. 478.

*Cliola storeriana* Abbott, l. c.

**Notropis analostanus (Girard).**

Silver Fin. Shiner.

Head  $3\frac{7}{8}$ ; depth  $4\frac{4}{5}$ ; D. II, 8; A. III, 8; scales 33 in lateral line to base of caudal, and 2 more on latter; 6 scales obliquely back from origin of dorsal to lateral line; 3 scales between origin of anal and lateral line; snout  $3\frac{1}{2}$  in head; eye  $3\frac{1}{4}$ ; maxillary 3; interorbital space 3; length of depressed dorsal  $1\frac{1}{6}$ ; of depressed anal  $1\frac{2}{5}$ ; least depth of caudal peduncle  $2\frac{1}{6}$ ; caudal 1; pectoral  $2\frac{2}{5}$ ; ventral  $1\frac{1}{2}$ ; pharyngeal teeth 1, 4-4, 1. Body moderately elongate, somewhat compressed, and profiles similarly convex. Head rather short and deep. Snout conic. Eye small, circular, anterior. Mouth oblique, quite small. Maxillary small, reaching orbit. Jaws even. Interorbital space broad and slightly convex. Gill-rakers 2 + 7 tubercular points. Scales narrowly imbricated. Lateral line low, of simple tubes. Origin of dorsal midway between front rim of orbit and base of caudal. Anal inserted just behind base of last dorsal ray, and about midway between middle of pectoral and base of caudal. Caudal emarginate. Pectoral not reaching ventral. Ventral inserted about opposite origin of dorsal and reaching anal. Color leaden-silvery. Edges of scales dusky. A dark vertebral line. A large blackish blotch in upper posterior part of dorsal. Paired fins, as well as lower part of belly, tips of anal and caudal, and front and upper parts of dorsal, charged with clear satiny-white pigment. Length  $1\frac{13}{16}$  inches. Crosswicks Creek near Trenton.

One of the most abundant of all the minnows in the Delaware. They occur in fresh-water streams, preferably those of the uplands above tide-water, sometimes in shoals of possibly a thousand individuals. They prefer the clear smaller streams, either quiet or

swift running. In late spring the males assume a very different appearance. Their fin-rays become enlarged or expanded and are heavily charged with the most brilliant satiny-white pigment, which has earned for the fish the name of silver fin. At this season of the year they are of the deepest and brightest shades. The top of the head is also covered with small horny excrescences which appear to soon fall off later, or during the summer. The female is not so deeply colored, though it too sometimes has a few horny excrescences. They frequent the shallows in clear rapids, swift ripples, and here one may see fifty or more all congregated in a restless and constantly surging bunch, each one apparently trying to make as much commotion in as small a space as possible. They are not so wary at this time and may easily be scooped out with a small dip-net. I have also seen them in the smallest brooks or rills, at most all seasons of the year. Often in midwinter they may frequently be seen disporting themselves with other numerous finny inhabitants of our brooks. At this season they are very plain-colored, and while very pretty form a great contrast to their vernal dress. When small they are also very difficult to distinguish from the red fin. The largest I have seen never exceeded 4 inches. They will take a worm on a small hook and are frequently the object of sport to the small boy.

*Hypsilepis analostanus* Abbott, Am. Nat., IV, 1870, p. 103.

*Hybopsis analostanus* Abbott, Am. Nat., VIII, 1874, p. 330.

*Cliola analostana* Abbott, Nat. Rambles, 1885, p. 478.

*Hypsilepis kentuckiensis* Cope, Trans. Am. Philos. Soc. Phila., XIII, 1869, p. 371, Pl. 2, fig. 3.—Abbott, Geol. N. J., 1868 (1869), p. 824.—Abbott, Am. Nat. IV, 1870, p. 100.

**Notropis cornutus** (Mitchill).

Red Fin. Shiner. Minny.

Head  $3\frac{7}{8}$ ; depth 3; D. II, 7, 1; A. III, 8, 1; scales 40 in lateral line to base of caudal, and 3 more on latter; 9 scales obliquely down from origin of dorsal to lateral line; 6 scales between origin of anal and lateral line in a vertical series; 22 scales before dorsal; snout  $3\frac{1}{2}$  in head; eye  $3\frac{1}{2}$ ; maxillary  $3\frac{1}{10}$ ; interorbital

space  $2\frac{3}{5}$ ; first branched dorsal ray  $1\frac{1}{4}$ ; first branched anal ray  $1\frac{3}{5}$ ; upper caudal lobe 1; least depth of caudal peduncle  $2\frac{1}{10}$ ; pectoral  $1\frac{1}{5}$ ; ventral  $1\frac{2}{7}$ ; pharyngeal teeth 2, 4-4, 2. Body compressed, rather short, anterior dorsal region a little swollen, and lower profile rather evenly convex. Caudal peduncle a little elongate. Head compressed, rather heavy and obtuse. Snout convex, rather blunt. Eye small, anterior, and circular. Mouth nearly horizontal, or but little inclined, and upper jaw projecting a little beyond lower. Maxillary not quite reaching orbit, and premaxillary level with lower portion of orbit. Nostrils superior, close together, and near front of eye above. Interorbital space broad and a little convex. Gill-rakers  $2 + 6$ , short points. Scales on sides and along lateral line narrowly imbricated, those before dorsal rounded and crowded. Tubes in lateral line simple, well decurved. Dorsal inserted nearer tip of snout than base of caudal, first branched ray longest, and fin when depressed reaching about half way to base of caudal. Anal inserted about midway between last third of pectoral and base of caudal, margin straight and first ray longest. Caudal deeply emarginate, lobes a little rounded. Pectoral reaching about four-fifths of space of ventral. Ventral inserted opposite origin of dorsal, and reaching vent, which is close in front of anal. Color grayish-blue above, scales with dusky edges. A bronzed line on each side along back. Belly and lower surface silvery, becoming rosy in spring. Dorsal dusky and caudal similar. Lower jaw and predorsal region to tip of snout covered with small tubercles. Length  $5\frac{1}{2}$  inches. New Jersey.

Like the preceding one of our abundant minnows. It is found in the same localities and has much in common. Also in the spring the male assumes a very different aspect. The head is found covered with numerous horny excrescences, and the fin-rays become enlarged and expanded. They are also charged with very brilliant coloring matter, or pigment, of bright red. The sides of the body are more or less rosy, and the entire coloration is emphasized or pronounced. They are very pretty, and are found with precisely the same habits as the silver fin, the males often bunching up by themselves in the riffles. At other times the larger

examples, for I have seen them nearly 8 inches long, appear to prefer deeper waters. Here they frequently take the bait intended for suckers (*Catostomus*). I have seen boys and itinerant gentlemen along the small creeks who apparently were catching strings of a dozen or more of these larger individuals for the purpose of serving as food. I have eaten them myself and find them palatable, though on account of their usual small size they are not considered important. Many examples from Crosswicks Creek, near Trenton, have been examined.

*Hypsilepis cornutus* Cope, Trans. Amer. Philos. Soc. Phila., XIII, 1869, p. 372, fig.—Abbott, Geol. N. J., 1868 (1869), p. 824.—Abbott, Am. Nat., IV, 1870, p. 100.—Abbott, l. c. VIII, 1874, p. 330.—Abbott, Rep. U. S. F. Com., 1875-76, p. 830.

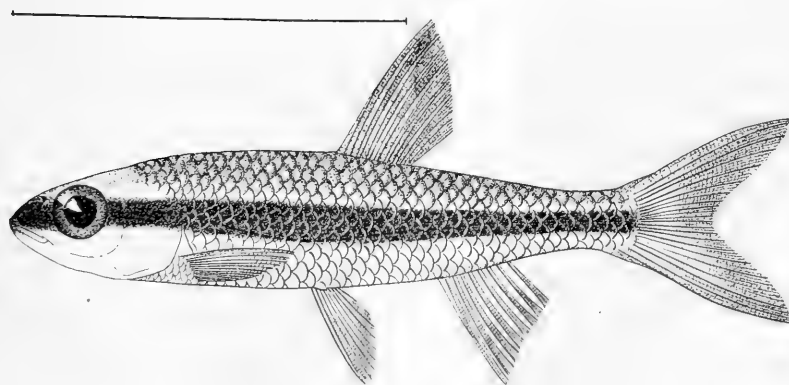
*Luxilus cornutus* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 110.

*Minnilus cornutus* Abbott, Nat. Rambles, 1885, p. 478.

*Leuciscus spiralingulus* Valenciennes, Hist. Nat. Poiss., XVII, 1844, p. 239, Pl. 506.

***Notropis chalybæus* (Cope).**

Minnie.



Minnie. *Notropis chalybæus* (Cope).

This fish which is hardly distinguishable from the next seems to differ only in color, which is altogether less bright and pronounced apparently during the breeding season.

I have no New Jersey examples. When in full breeding dress

it is one of the most beautiful of minnows. The lower surface of the body and pale area adjoining the black longitudinal band is a rich orange. They usually associate with other small fishes, such as the minnow (*Notropis bifrenatus*), the roach (*Brama crysoleucas*), mullet (*Erimyzon sucetta oblongus*), long eared sun fish (*Lepomis auritus*), banded sun fish (*Mesogonistius chatodon*), spotted sun fish (*Enneacanthus gloriosus*), and yellow ned (*Perca flavescens*).

*Hybopsis chalybæus* Abbott, Geol. N. J., 1868, p. 825.

*Hybopsis chalybæus* Abbott, Am. Nat., VIII, 1874, p. 331.

*Minnilus chalybæus* Abbott, Nat. Rambles, 1885, p. 478.

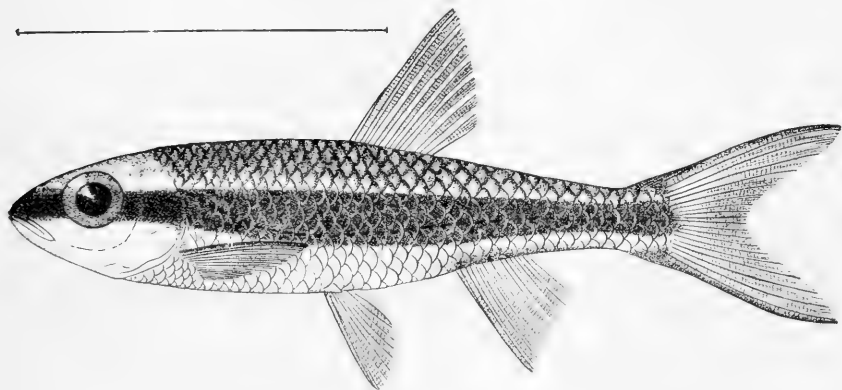
***Notropis chalybæus abbotti* Fowler.**

Abbott's Minnow.

Head  $3\frac{3}{4}$ ; depth  $4\frac{2}{5}$ ; D. 11, 7; A. 11, 7; scales 33 in lateral line to base of caudal; 17 scales before dorsal; 7 scales obliquely back from origin of dorsal to lateral line; 4 scales obliquely forward from origin of anal to lateral line; snout  $3\frac{1}{3}$  in head; eye 3; maxillary  $3\frac{1}{3}$ ; interorbital space  $2\frac{3}{7}$ ; depressed dorsal 1; anal  $1\frac{1}{5}$ ; pectoral  $1\frac{2}{5}$ ; ventral  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{4}{5}$ ; caudal  $3\frac{2}{5}$  in head and trunk; pharyngeal teeth 2, 4-4, 2. Body robust, elongate. Lower profile a little more convex than upper. Head rather large, robust, somewhat conic in front. Snout broad, convex. Eye circular, anterior. Mouth small, oblique, jaws about even. Lips rather fleshy. Maxillary small, barely reaching beyond posterior nostril or to front rim of orbit. Gill-rakers few, weak and small. Scales large, those in front of dorsal somewhat crowded in appearance. Origin of dorsal nearer base of caudal than tip of snout. Anal inserted well behind last dorsal ray in vertical. Caudal rather long and forked, lobes pointed. Pectoral not reaching ventral, or about  $\frac{3}{4}$  of space. Ventral placed well before dorsal, not reaching anal. Color pale brown, each scale with blackish-dusky edge. A broad black band, as wide as eye on costal region, from snout to base of caudal where it forms a spot. Along base of anal a bar of dusky fading out on lower surface of caudal peduncle. Dorsal, caudal and

upper edge of pectoral pale dusky. Length  $2\frac{5}{16}$  inches. Batsto River. Type of *Notropis chalybaeus abbotti* Fowler. There are also eighteen paratypes with the same data.

Color in life clear brownish on back, above and top of head dusky tinted with a pale brownish. An indistinct median dusky shade from occiput to dorsal. Edges of scales of back dusky. Back and upper surface in some lights showing metallic tints of pale brassy and golden and having in this also a more or less transparent effect, especially in sunlight. In the same it is also very distinct about the costal region, due to the pale peritoneum which encircles the air-vessel above. Lower surface of body whitish in young examples, posteriorly more translucent than in



Abbott's Minnow. *Notropis chalybaeus abbotti* Fowler.

adults. Peritoneum showing through bright silvery-white. Lower surface of head silvery-white. A jet-black lateral band a little wider than pupil extends from tip of snout, includes tip of mandible, crosses iris and side of head and reaches base of caudal, which in some lights has a most resplendent or brilliant blue-green sheen. Adjoining black lateral band above a pale area, separating former from color of back. Abdomen medianly with a number of blackish points. Along base of anal, and continued thence also on preanal region in some cases, and lower side of caudal peduncle in others, are also a number of blackish points, most distinct or pronounced along base of anal. Fins transparent more or less. Caudal with a dilute umber-brown

tint. Dorsal dilute dusky. Pectoral transparent like other fins, or only a little dusky along the upper margin. In some lights sides of head with purplish and golden reflections. Iris silvered. Adult. Egg Harbor River at Mare Run. April 23d, 1905. This beautiful little fish, in company with *Mesogonistius chætodon*, was found to be exceedingly abundant in the little channels and runs in the sphagnum banks. They associate in large schools.

I have a large series from the Rancocas affluents of the Delaware basin, near Brown Mills, which may however belong to the true *N. chalybæus*, as they have faded while long in alcohol.

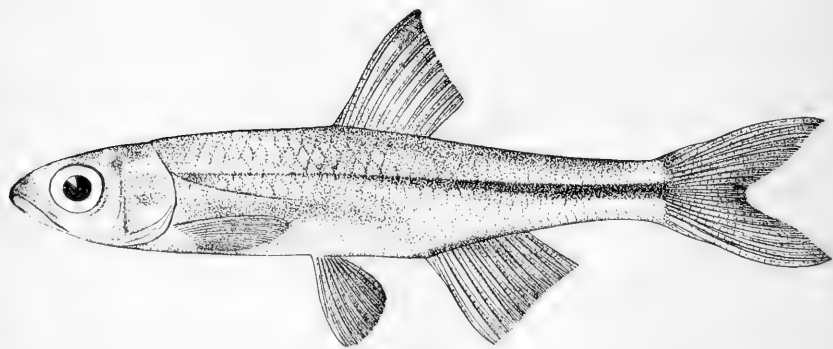
?*Leuciscus* sp.? Baird, 9th An. Rep. Smiths. Inst., 1854, p. 342.

*Cliola chalybæa* Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132.

*Notropis chalybæus abbotti* Fowler, Proc. Acad. Nat. Sci. Phila., 1904, p. 239, Pl. 17, upper figure.

**Notropis amœnus (Abbott).**

Attractive Minnow.



Attractive Minnow. *Notropis amœnus* (Abbott). (Young.)

Head  $4\frac{1}{4}$ ; depth  $4\frac{2}{3}$ ; D. 1, 8; A. 1, 11; scales 5-39-3; pharyngeal teeth 1, 4-4, 1; eye  $3\frac{1}{4}$  in head. Head rather short and broad, and profile less pointed anteriorly to orbit. Orbit large, equal to length of muzzle, and but a trace less interorbital space. Pharyngeal teeth moderately hooked, with narrow masticatory



surface, and single tooth similar to others but only half size. Occasionally teeth 3, 4-4, 2. Lateral line decurved from upper angle of opercle, continues slightly oblique till some distance beyond dorsal, but not rising again opposite that fin and continuing to caudal. Insertion of dorsal slightly behind that of ventral, and last ray slightly in advance of anal. Anal broad, its base equal to anterior ray, and edge slightly concave. Caudal forked or emarginate. Pectoral terminates at a distance of 3 scales width from ventral. Ventral reaches opposite fifth dorsal ray. Color pale olive above with minute black dots on exposed edges of scales. A bright silvery band, 3 scales wide at opercle, and narrowing to  $1\frac{1}{2}$  scales at base of caudal fin. Belly opaque white. Opercle and iris pure silvery. Length  $3\frac{1}{2}$  inches. In the summit level of the Delaware and Raritan Canal, which has an unobstructed outlet into the Raritan River, 25 miles east of the Delaware. (Abbott.)

This fish I have never taken in the Delaware or New Jersey, but contrary to Dr. Abbott's statement of 1874, I have since found within the Susquehanna basin. According to that writer it is rare. It may be distinguished from our other species of *Notropis* by the teeth and the increased anal rays. The type was sent to the Peabody Academy.

*Alburnellus amænus* Abbott, Am. Nat., VIII, 1874, p. 334.

*Alburnus amænus* Abbott, l. c., fig. 78.

*Minnilus amænus* Abbott, Nat. Rambles, 1885, p. 479.

## Genus RHINICHTHYS Agassiz.

### The Black Nosed Dace.

#### *Key to the species.*

- a. Snout long, prominent, projecting notably beyond mouth, about twice length of eye in adult; barbel evident. CATARACTÆ
- aa. Snout shorter, projecting little beyond small mouth, its length  $1\frac{1}{2}$  times in eye in adult; barbel minute, obsolete. ATRONASUS

*Rhinichthys cataractæ* (Valenciennes).

## Long Nosed Dace. Dace.

Head  $3\frac{1}{3}$ ; depth  $4\frac{3}{4}$ ; D. 11, 7, 1; A. 11, 6, 1; scales 60 in lateral line to base of caudal and 3 more on latter; 12 scales obliquely back from origin of dorsal to lateral line; 9 scales in a vertical series between origin of anal and lateral line; 30 scales before dorsal; snout  $2\frac{1}{2}$  in head; eye  $4\frac{2}{5}$ ; maxillary  $3\frac{1}{6}$ ; interorbital space  $3\frac{1}{2}$ ; first branched dorsal ray  $1\frac{1}{4}$ ; first branched anal ray  $1\frac{2}{5}$ ; least depth of caudal peduncle  $2\frac{2}{7}$ ; pectoral  $1\frac{1}{10}$ ; ventral  $1\frac{1}{2}$ ; pharyngeal teeth 2, 4-4, 2. Body rather long, compressed, robust. Head moderate, conic. Snout convex, blunt and well protruding. Eye circular, a little anterior. Mouth low, inferior, and nearly horizontal. Lips fleshy. Barbel at extremity of maxillary prominent. Upper lip below level of orbit. Maxillary reaching about three-fourths of space to orbit. Nostrils close in front of orbit, posterior large. Interorbital space broad, flattened. Gill-rakers 1 + 5 short points. Scales small, crowded anteriorly and on predorsal region. Lateral line a little decurved and of simple tubes, complete. Dorsal inserted midway between anterior margin of orbit and base of caudal, and reaching half way to latter. Anal inserted opposite base of last dorsal ray, margin of fin straight, and extending three-fourths of space to base of caudal. Caudal a little emarginate. Pectoral reaching ventral. Ventral inserted nearer tip of snout than base of caudal, well before dorsal, and reaching nearly to anal. Vent close in front of anal. Color olive, paler below. Back and side with numerous dusky mottlings. A dark streak on lips. Dorsal and caudal pale dusky, other fins reddish. Length  $3\frac{3}{8}$  inches. Budd Lake.

This little dace— for it never exceeds more than 5 inches— differs from the common species in the long prominent snout, which projects well beyond the mouth. It is found in clear rushing torrents, most always in the rapids or rock pools. In spring it is a beautiful little fish, but is perhaps less gorgeous than the following. Dr. Abbott tells me he has found it sparingly only

in McCall's brook at Trenton. He also states that it is less abundant than the following.

*Argyreus nasutus* Cope, Trans. Am. Philos. Soc. Phila., XIII, 1869, p. 369, fig., Pl. 12, fig. 5.—Abbott, Geol. N. J., 1868 (1869), p. 824.

*Rhinichthys nasutus* Abbott, Am. Nat., VIII, 1874, p. 328.—Abbott, Nat. Rambles, 1885, p. 479.

***Rhinichthys atronasus* (Mitchill).**

Dace. Black Nosed Dace. Striped Dace.

Head  $3\frac{7}{8}$ ; depth 5; D. II, 7, 1; A. III, 6, 1; scales 60 in lateral line to base of caudal; 11 scales obliquely back from origin of dorsal to lateral line; 9 scales between origin of anal and lateral line in a vertical series; about 38 scales before dorsal; snout 3 in head; eye  $3\frac{4}{5}$ ; maxillary 4; interorbital space  $3\frac{1}{8}$ ; first branched dorsal ray 2; first branched anal ray  $1\frac{1}{4}$ ; least depth of caudal peduncle  $2\frac{2}{3}$ ; pharyngeal teeth 2, 4-4, 2. Body moderately elongate, little compressed, and profiles similar. Head moderate, conic, rather broad above. Snout rather broad and conic. Eye circular, a little anterior. Mouth small, a little inferior, and with upper jaw slightly protruding. Barbel minute, terminal on maxillary. Maxillary reaching about half way to orbit. Upper lip level with lower part of pupil. Nostrils close in front of eye above. Interorbital space broad and flattened. Gill-rakers 1 + 4 short weak points. Scales small, somewhat embedded, and crowded on predorsal region. Lateral line of simple tubes, complete. Dorsal inserted about midway between posterior margin of orbit and base of caudal, and when depressed reaching about half way to latter. Anal long, inserted just behind base of last dorsal ray, or nearer tip of pectoral than base of caudal, and reaching three-fourths of space to latter. Caudal emarginate. Pectoral two-thirds of space to ventral. Ventral inserted before dorsal or a little nearer base of caudal than tip of snout, and reaching vent, which is close in front of anal. Color dusky-olive above mottled with blackish. Below silvery-white. A black band from snout through eye to base of caudal, where it ends in a

black blotch. Fins below yellowish-orange, dorsal and caudal dull olive. Length  $2\frac{3}{4}$  inches. Budd Lake.

The most abundant of all our small fishes in streams of fresh water. They are seldom found in the creeks or wider streams in such abundance as in the small brooks of clear water, particularly if rapid. They also like the quiet little pools or deeper places. Here they may often be seen swimming persistently against the current, sometimes gaining a few inches or again slipping back perhaps further, and then darting suddenly away when disturbed, only to be seen, however, back again repeating the same performance over and over. One may scoop every individual from the brook before they will desert a favorite place entirely. This is a most beautiful species and in life is found to vary considerably even in the same stream. I have found as many as a dozen different individual variations in a single brook in the spring of the year. Ordinarily in life the adult male is a beautiful olivaceous-brown on the upper surface, each scale with defined though only slightly darker edges, and the whole region all specked or dotted with blackish. Median line of back only very slightly paler. Below white with silvery, showing tints of purplish and bluish in some lights. Jaws whitish. Opercle with green and golden reflections in some examples. A dusky or blackish-brown band laterally from snout through eye to base of caudal and also reflected on bases of median rays of latter. A brassy or coppery line reflected along dark lateral band above, but narrow. Dorsal and caudal dilute brown. Pectoral golden basally, otherwise whitish. Ventral and anal dilute brownish-white. A rather common more or less russet variety has back brown and upper surface of head slightly tan-color. Lower surface of head and body white. On the back each scale has a slightly darker edge, though not those of lateral band. A black band encircles snout through iris to opercle. After this it becomes bright russet and continues to base of caudal, where it is with more or less blackish medianly. Back and lateral band also with small black specks or granulations, median line of back paler. Dorsal, caudal and anal dilute olivaceous more or less tinged with russet, especially latter two fins. Pectoral deep brick-red except lower rays, which are white. Axil of pectoral bright red. Ventral dilute

olivaceous, basally red. Inside of gill-opening russet and blackish. Iris white except where crossed by black lateral band.

*Cyprinus atronasus* Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 95.

*Argyreus atronasus* Cope, Trans. Amer. Philos. Soc. Phila., XIII, 1869, p. 369.—Abbott, Geol. N. J., 1868 (1869), p. 824.—Abbott, Am. Nat., IV, 1870, p. 100.

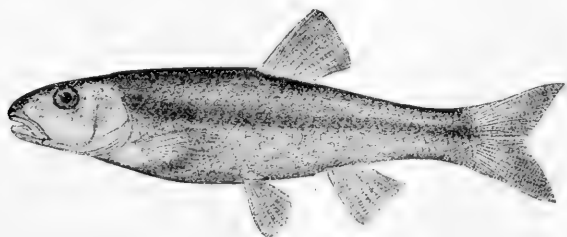
*Rhinichthys atronasus* Abbott, Am. Nat., VIII, 1874, p. 328.—Jordan, An. N. Y. Acad. Sci., I, 1879, p. 108.—Abbott, Nat. Rambles, 1885, p. 479.

### Genus *HYBOPSIS* Agassiz.

#### The Horny Heads.

#### *Hybopsis kentuckiensis* (Rafinesque).

This chub may be distinguished from the other minnows with a barbel at the extremity of the maxillary chiefly by its larger



Horny Head. *Hybopsis kentuckiensis* (Rafinesque).

scales and fewer teeth, the inner row never more than one and frequently absent.

The adult male is a beautiful animal, and in the spring the snout or nose is greatly swollen, reminding one of the hooded seal. The young have a dark longitudinal band and are dull olivaceous in color. This fish is only known from Mr. Eugene Smith's record of two examples from the Passaic River.

*Hybopsis kentuckiensis* E. Smith, Proc. Lin. Soc. N. Y., IX, 1897, p. 27.

Genus EXOGLOSSUM Rafinesque.

The Cut Lips Minnows.

**Exoglossum maxillingua** (Le Sueur).

PLATE 13.

Cut Lips Minnow.

This peculiar little minnow may be distinguished at a glance from any of the others by its trilobate mandible.

I have never seen any New Jersey examples and include it on the authority of Mr. Eugene Smith, who found it at Peckman's Brook, where the Morris Canal crosses the brook near Little Falls, in Passaic County.

*Exoglossum maxillingua* E. Smith, Science, XXII, July, 1905, p. 119.

Family CATOSTOMATIDÆ.

The Suckers.

Body oblong or elongate, usually more or less compressed. Belly not serrated. Head more or less conical. Eye small. Mouth large or small, usually protractile and with fleshy lips. Margin of upper jaw formed in middle by small premaxillaries, and on side by maxillaries. Jaws toothless. No barbels. Nostrils double. Opercles normally developed. Gill-membranes more or less united to isthmus, restricting gill-membranes to sides. Gills 4, a slit behind fourth. Pseudobranchiæ present. Branchiostegals 3. Lower pharyngeal bones falciform, armed with a single row of numerous comb-like teeth. Alimentary canal long. Stomach simple. No pyloric cæca. Air-vessel large, divided into 2 or 3 parts by transverse constrictions, not surrounded by a bony capsule. Scales cycloid, large or small. Head naked, fins not scaly. Lateral line decurved, sometimes wanting. Dorsal fin comparatively long, of 10 to 50 rays without true spine. Anal fin short. No adipose fin. Caudal fin more or less

forked. Pectoral fins placed low, without spine. Ventrals abdominal, with about 10 rays.

Fishes of moderate size mostly in the fresh-waters of North America, ascending streams in large numbers in the spring. As they are flavorless and full of small bones, they are not much valued as food-fishes.

*Key to the genera.*

- |  |            |
|--|------------|
| a. Air-vessels in 2 parts.               |            |
| b. Lateral line complete and continuous. | CATOSTOMUS |
| bb. Lateral line wanting.                | ERIMYZON   |
| aa. Air-vessel in 3 parts.               | MOXOSTOMA  |

Genus CATOSTOMUS Le Sueur.

The Fine Scaled Suckers.

*Key to the species.*

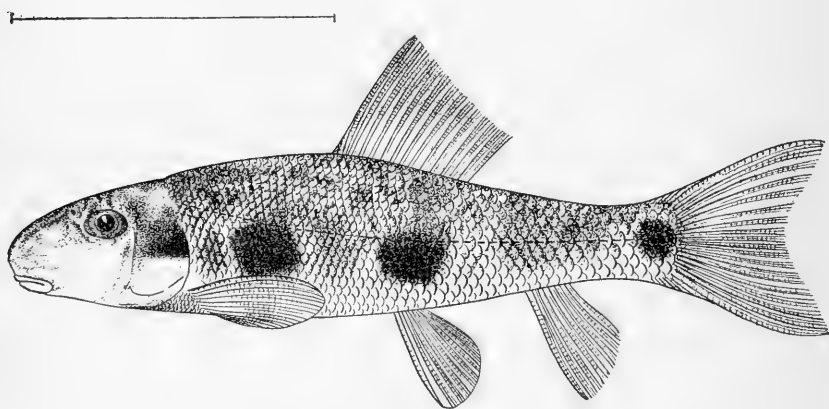
- |   |               |
|---|---------------|
| a. Head transversely convex above; orbital rim not elevated; scales in lateral line 64 to 68, crowded anteriorly.           | COMMERSIONNII |
| aa. Head broad, depressed and transversely concave between orbits; scales in lateral line 48 to 55, not crowded anteriorly. | NIGRICANS     |

**Catostomus commersonnii** (Lacépède).

Sucker. River Sucker. White Sucker.

Head  $3\frac{4}{5}$ ; depth  $4\frac{1}{8}$ ; D. II, 10, 1; A. III, 7; scales 60 in lateral line to base of caudal and 3 more on latter; 11 scales obliquely back from origin of dorsal to lateral line; 6 scales between origin of anal and lateral line; about 24 scales before dorsal; snout  $2\frac{7}{8}$  in head; eye  $3\frac{1}{2}$ ; width of mouth 4; interorbital space  $2\frac{1}{2}$ ; first branched dorsal ray  $1\frac{2}{5}$ ; fourth anal ray  $1\frac{3}{7}$ ; least depth of caudal peduncle  $2\frac{4}{5}$ ; pectoral  $1\frac{1}{5}$ ; ventral  $1\frac{4}{7}$ . Body rather elongate, robust at predorsal region. Head large, stout, conic, flattened above, and upper profile rather convex. Snout long, blunt, moderately prominent, though scarcely protruding beyond mouth. Eye a little elongate and a trifle anterior. Mouth rather large with strongly papillose lips, upper with 2 rows. Preorbital

about as long as orbit. Nostrils together in front of eye above. Interorbital space broad and slightly convex. Gill-rakers about  $8 + 15$  short weak points. Scales on anterior portion of body crowded above, on caudal peduncle large. Lateral line of simple tubes, a little decurved, median. Dorsal inserted midway between tip of snout and base of caudal, and depressed fin reaching a trifle over half way to latter. Anal inserted a little nearer base of last dorsal ray than base of caudal, and depressed fin reaching a little beyond latter. Caudal a little emarginate and rather broad. Pectoral a little long, reaching opposite origin of dorsal. Ventral about opposite middle of base of dorsal, or  $\frac{3}{4}$  of space to



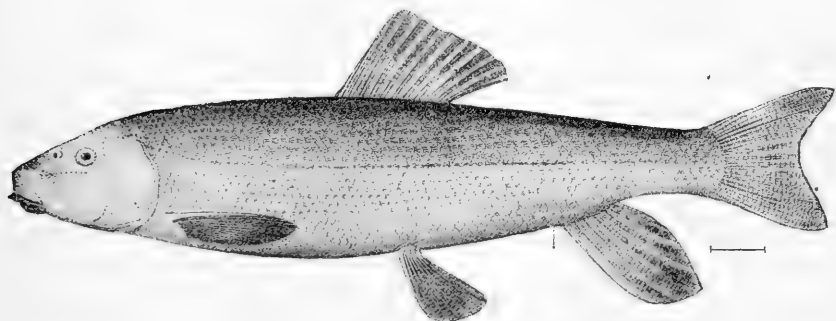
Sucker. *Catostomus commersonnii* (Lacépède). (Young.)

anal. Color olive, pale below. Back and sides mottled with dusky. Length  $3\frac{1}{2}$  inches. Crosswicks Creek near Trenton.

This is the most abundant sucker in the Delaware. During the winter months it is sought for by anglers, and is then a tolerably good food-fish. As the warm spring days approach they begin to form schools and ascend the creeks and small streams in numbers, when they are mostly taken in cast-nets. The best time for this fishing is during a warm spell after a rain when the water becomes muddy. The fisherman usually wades into shallow pools among rapids, or frequently with more success if near the foot of a water-fall. Loud talking or even shouting does not appear to disturb the fish, as on such occasions I have noticed



that the net seldom failed to land at least several. Possibly this is due to the muddy water combined with the roar or noise it produces in its course over the rocks. Any sudden motion one may make from the bank, should the water be clear, however, will usually startle them. When first caught they do not struggle, save an occasional spasmodic jerk or two, though all the while constantly moving the branchial apparatus as if to force water over their gills. They are hardy, and will live several hours entirely out of water. The fish are equally active at night, so that the cast-net fishing has been carried on then with equal success. In clear water these fish may often be seen lying quietly, sometimes in large numbers, bunched together in deep pools or hol-



Sucker. *Catostomus commersonnii* (Lacépède). (Adult.)

lows. When disturbed, as by any sudden motion or shadow, they dart quickly under the shelter of the banks, or among the rocks, though they will swim a considerable distance in a perfectly straight course. At other times they appear stupid and are then easy to secure with a small dip-net. In small streams quite large examples will frequently swim rapidly over the shallows to the deeper pools. Sometimes they appear greatly disturbed, darting wildly about. When taken on a hook they seldom make much disturbance, usually taking the bait almost imperceptibly and the float hardly bobbing. The tension on the line is then very slight until the fish is raised from the water, when it jerks about somewhat, though usually not causing much disturbance or excitement for the angler. The fisherman keeps

his catch alive more or less submerged in the water. The bait is the common earth-worm. At times they are attacked by lampreys, which bore into them, as in the case of the shad. The young, though most abundant in small clear brooks, may easily be distinguished by their beautiful variegated color pattern, and are quite attractive in the aquarium. They also have the lateral line inconspicuous, or entirely absent when very young. The adults are rosy-tinted during the spring or spawning season, and the males sometimes with a faint rosy lateral band. The anal and lower caudal lobe of the male is also covered with small tubercles, and the fins, together with the pectorals and ventrals, are also highly charged with more or less bright red pigment in both sexes. In the Great Egg Harbor River they do not appear to ascend above the dam at May's Landing. My examples are from Crosswicks Creek, near Trenton, where it is abundant.

*Catostomus commersoni* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 114.

*Catostomus commersonii* Evermann, Recreation, April, 1902, p. 292.

*Catostomus communis* Le Sueur, Journ. Acad. Nat. Sci. Phila., I, 1817, p. 95.—Abbott, Nat. Rambles, 1885, p. 479.

*Catostomus bostoniensis* Abbott, Geol. N. J., 1868, p. 825.—Abbott, Am. Nat., IV, 1870, p. 390.

*Catostomus teres* Bean, Bull. U. S. F. Com., VII, 1887, p. 150.

***Catostomus nigricans* (Le Sueur).**

Black Sucker. Mud Sucker.

Head  $3\frac{2}{3}$ ; depth  $4\frac{2}{3}$ ; D. III, 10, 1; A. III, 6, 1; scales 47 in lateral line to base of caudal, and 3 more on latter; 7 scales obliquely back from origin of dorsal to lateral line; 5 scales obliquely up from base of ventral to lateral line; snout  $1\frac{2}{3}$  in head; eye 5; interorbital space  $2\frac{1}{10}$ ; least depth of caudal peduncle 3. Body rather elongate, tapering from dorsal fin. Head thick, attenuated inferiorly to mouth. Eye small, high, posterior, and a little ellipsoid. Lips thick, upper especially so.

with broad free margin, and furnished with as many as 10 series of papillæ. Lower lip deeply incised. Interorbital space broad and concave. Nostrils close in front of eye. Fontanel short. Dorsal midway in length. Anal long, midway between base of last dorsal ray and base of caudal. Caudal emarginate. Pectoral broad, not quite reaching ventral, which is inserted a little before middle of base of dorsal. Ventral reaching  $\frac{2}{3}$  of space to anal. Color olivaceous above, whitish below. Back generally marked with deeper cross blotches, irregular and less distinct in the old. Lower fins reddish in life. Length  $9\frac{1}{2}$  inches. New Jersey.

This large sucker reaches a length of 2 feet. The young are considerably variegated with spotted sides. It is an inhabitant of clear, swift, rocky streams, and is less tenacious of life than our other species. Though the specimen I described was labelled from New Jersey, it is likely that the species only occurs in the northwestern and northern regions. I have never noted it in any of the smaller coastwise streams. Dr. Abbott states that it is found in Crosswicks Creek in water that was more or less muddy. This is at variance with my experience in other places, where it was found almost entirely in perfectly clear cold streams.

*Hylomyzon nigricans* Abbott, Geol. N. J., 1868, p. 825.—Abbott, Amer. Nat., IV, 1870, p. 113.—Abbott, l. c., p. 389.

*Hypentelium nigricans* Abbott, Nat. Rambles, 1885, p. 479.

*Catostomus (Hylomyzon) nigricans* Abbott, Am. Nat., IV, 1870, p. 386.

### Genus ERIMYZON Jordan.

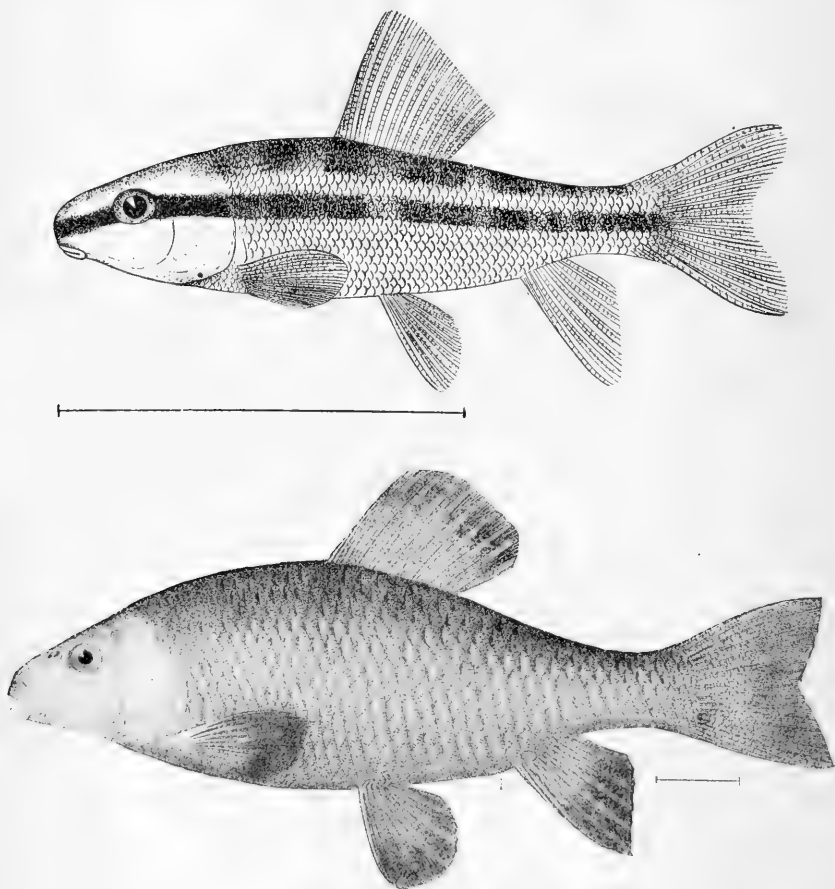
#### The Chub Suckers.

*Erimyzon sucetta oblongus* (Mitchill).

#### Mullet. Chub Sucker.

Head  $3\frac{5}{6}$ ; depth  $2\frac{9}{10}$ ; D. IV, 12, 1; A. III, 6, 1; scales 43 in lateral line to base of caudal, and 3 more on latter; about 16 scales between origins of dorsal and ventral; about 16 scales before dorsal; snout 2 in head; eye  $4\frac{1}{2}$ ; interorbital space  $2\frac{1}{6}$ ; third branched dorsal ray  $1\frac{1}{6}$ ; second branched anal ray  $1\frac{1}{8}$ ;

lower caudal lobe 1; least depth of caudal peduncle  $2\frac{2}{3}$ ; pectoral  $1\frac{1}{4}$ ; ventral  $1\frac{1}{4}$ . Body compressed, rather oblong, and predorsal region more or less elevated. Caudal peduncle rather short and compressed. Head short, stout, and upper profile a little more inclined than lower. Snout long, blunt, or with profile



Chub Sucker. *Erimyzon sucetta oblongus* (Mitchill).  
(Upper figure young, lower adult.)

in front vertical. Eye circular, anterior, and  $1\frac{2}{3}$  in preorbital. Mouth inferior, moderate, upper lip well developed and freely protractile, and lower moderate,  $\Lambda$ -shaped in outline, infolded, plicate. Nostrils superior, close to eye above. Interorbital space

broad and slightly convex. Opercle smooth. Gill-rakers  $9 + 14$ , slender, longest equals pupil. Scales of rather uniform size, and not much crowded on predorsal region. Dorsal inserted a little before tip of pectoral or much nearer tip of snout than base of caudal. Anal inserted about midway between base of sixth branched dorsal ray and base of caudal, and reaching beyond latter. Caudal a little emarginate, lobes rounded. Pectoral extending four-fifths of space to ventral. Ventral inserted about opposite base of fourth branched dorsal ray, and extending four-fifths of space to anal. Dark olive on back, paler below, and dusky shades above. Fins with dusky. Length 7 inches. Batsto River.

The adult is olivaceous above in life, sides paler, and lower surface becoming white. Body, especially sides, with brassy reflections. A pale band, most distinct when fish is in the water, extends from upper end of gill-opening to base of upper caudal lobe. This indistinctly defines black lateral band of young which has almost completely faded. A median pale streak extends from tip of snout to base of caudal, also distinct when fish is in water. Side of head with brassy reflections, and its lower surface opaque-white like lower surface of abdomen. Iris of three circles of color, one next to pupil pink, next pale gray, and outer one white. Dorsal and caudal dark or dusky, membranes deeper than rays, which are somewhat dilute ruddy. Anal dusky, rays becoming translucent brownish-white basally, former with upper margin same, and lower or inner rays of both fins ruddy, becoming deep or wine-color somewhat in middle of fins. Inside of gill-opening pearl-colored. This example from tributary of Crosswicks Creek, near Trenton, taken in May, 1904.

A young example  $2\frac{3}{8}$  inches long, in the *vittatus* stage, was taken in the same locality. When living the ground color of back was pale brownish-olivaceous and edge of each scale distinctly darker. Along middle of side a dusky or black band, less than pupil, extending from tip of snout to base of caudal, where it is intensified in some examples. Lower surface, or below band, opaque-white with a silvery sheen. Lips white. Above black lateral band a paler shade than ground-color of back, and edges

of some scales also slightly darker. Darker color of back with eight transverse rather broad deep olive-dusky bars, and also appearing at intervals, though mostly indistinct, on dark median lateral band. First crosses from front of eye, second over inter-orbital space, third above opercle, fourth midway in space to dorsal, fifth begins at origin of dorsal, sixth begins at bases of last dorsal rays, and others on caudal peduncle at equal distances. Fins pale, dorsal and caudal pale grayish-dusky. Dorsal tinted slightly with dilute ruddy basally, outer marginal portion much deeper colored. Pectoral, ventral and anal slightly dusky along edges. Iris pale brownish-white.

A young example from the Great Egg Harbor River above May's Landing taken April 23d, 1905, was brownish on back in life. A distinct dusky-blackish shade from snout along and broadly on each side of head and back, leaving a narrow paler median brown streak from opposite nostril to dorsal. A black lateral band from snout not including mandible through eye to base of caudal. Adjoining black lateral band above a narrow pale band of a similar shade of brown to that medianly on pre-dorsal region. Lower surface of body including head white. Costal region and lower side of head with beautiful purplish-golden or rosy reflections. Fins dilute brownish, caudal with a reddish shade, basally most distinct, and edges of fins dusky. Dorsal more or less dusky anteriorly with edge especially so. Fin otherwise with rosy tint of caudal. Other fins transparent, marked with pale dusky dots. Anal perhaps a little more dusky than others. Vent encircled with dusky dots. Iris mostly silvery with rosy or purplish tints. These fish were found abundantly with *Notropis chalybæus abbotti* in the sphagnum banks, especially about Mare Run. They all appeared much darker than Delaware River examples.

Equally abundant with the common sucker (*Catostomus commersonnii*), though distinguished by most fishermen as "mullet." I have only taken the young during the winter. It wanders up the streams in much the same way during the spring, running in schools. I have examples from Brown Mills and Crosswicks Creek.

*Moxostoma oblongum* Abbott, Geol. N. J., 1868, p. 825.—Abbott, Am. Nat., IV, 1870, pp. 100, 113.—Abbott, l. c., pp. 386, 389.—Abbott, Rep. U. S. F. Com., 1875-76, p. 841.

*Erimyzon oblongus* Bean, Bull. U. S. F. Com., VII, 1887, p. 150, Pl. I, fig. 20.

*Catostomus gibbosus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 341.

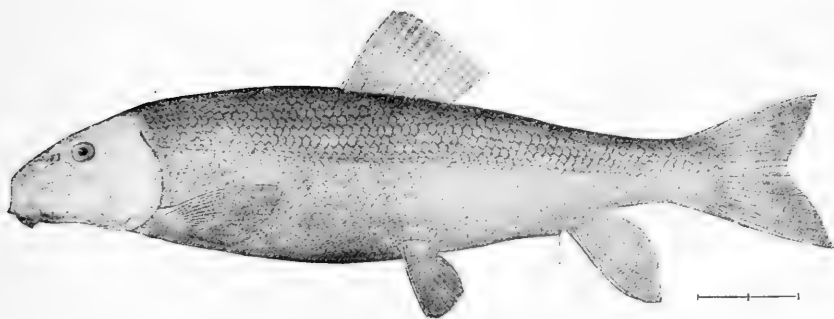
*Erimyzon sucetta* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 114.—Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132.—Abbott, Nat. Rambles, 1885, p. 479.—Bean, Bull. Am. Mus. N. H., IV, 1879, p. 332.—Evermann, Recreation, April, 1902, p. 292.

### Genus *MOXOSTOMA* Rafinesque.

#### The Red Horses.

#### *Moxostoma macrolepidotum* (Le Sueur).

#### River Sucker.



River Sucker. *Moxostoma macrolepidotum* (Le Sueur).

This fish may be distinguished from the other suckers within our limits by the air-vessel, which is in three parts.

I have never seen this fish from the Delaware. Dr. Abbott tells me that among material which he collected near Trenton were some specimens of this species which were identified by Cope.

*Catostomus macrolepidotus* Le Sueur, Journ. Acad. Nat. Sci. Phila., 1817, pp. 94, 111.

*Teretribus macrolepidotus* Abbott, Am. Nat., IV, 1870, p. 117.

*Teretulus macrolepidotus* Abbott, l. c., p. 390.

*Myxostoma macrolepidotum* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 115.

*Myxostoma macrolepidota* Abbott, Nat. Rambles, 1885, p. 479.

? *Carpiodes cyprinus* Abbott, l. c.

## Order NEMATOGNATHI.

### The Cat Fishes.

Represented in our waters by a single family, the *Siluridæ* or true cat fishes.

### Family SILURIDÆ.

### The Cat Fishes.

Body more or less elongate. Anterior part of head with two or more barbels, base of longest pair formed by small or rudimentary maxillary. Margin of upper jaw formed by premaxillaries only. Subopercle absent. Opercle present. Air-vessel usually present, large, and connected with organ of hearing by means of auditory ossicles. Lower pharyngeals separate. Body naked or covered with bony plates, no true scales. Dorsal fin usually present, short, above or in front of ventrals. An adipose fin usually present. Anterior rays of dorsals and pectorals usually spinous.

A large family, mostly in the fresh waters of warm regions. Most of the marine forms are tropical. They are valued as food-fishes, though in some places are not used on account of their foul habits.

### Key to the genera.

- a. TACHYSURINÆ. Nostrils close together, neither with a barbel, and posterior with a valve; teeth on palate; caudal forked; chiefly marine.

FELICHTHYS

- aa. ICTALURINÆ. Nostrils remote from each other; posterior nostril with a barbel; no teeth on vomer or palatine; caudal usually rounded; fresh-water species.

- b. Adipose fin with its posterior margin free.

AMEIURUS

- bb. Adipose fin keel-like, adnate to back.

SCHILBEODES



Genus FELICHTHYS Swainson.

The Gaff Topsail Cat Fishes.

**Felichthys marinus** (Mitchill).

PLATE 14.

Sea Cat Fish. Salt Water Cat. Sea Cat. Channel Cat.  
Oceanic Cat Fish.

Head 4; depth  $4\frac{2}{3}$ ; D. I, 7; A. iv, 16; width of head  $1\frac{1}{4}$  in its length; snout  $2\frac{3}{4}$ ; eye  $6\frac{3}{5}$ ; width of mouth  $1\frac{7}{8}$ ; inter-orbital space  $1\frac{2}{3}$ ; least depth of caudal peduncle  $3\frac{2}{3}$ ; pectoral spine  $1\frac{1}{7}$ ; ventral fin  $1\frac{1}{2}$ . Body long, back elevated to origin of dorsal, and lower surface anteriorly depressed. Head broad, depressed, rather short, and rounded anteriorly with broad snout. Eye large, elongate, anterior. Mouth broadly crescent-shaped. Bands of villiform teeth on vomer and palatines forming crescent-shaped band parallel to those in jaws. Maxillary barbels reaching a trifle beyond tip of pectoral spine. Mental barbel about 2 in interorbital space. Interorbital space broadly convex with rather broad depression of fontanel in center. Gill-rakers rather short and few. Occipital buckler oblong, not much broader before than behind. Dorsal inserted close behind head, its spine shorter than that of pectoral, and with long filament. Anal inserted a little nearer base of caudal than origin of dorsal, and lobe extending back further than tip of last ray. Caudal deeply forked, lobes slender, pointed, and upper longer. Adipose fin over middle of base of anal. Pectoral filament reaching beyond ventral's base. Ventral inserted about midway between tip of snout and base of caudal, and reaching anal. Color dusky-bluish above, below silvery. Length  $16\frac{3}{4}$  inches. Great Egg Harbor Bay.

Dr. C. C. Abbott records this fish from the lower Delaware waters, though it is unusual out of salt-water. I have several examples from the Great Egg Harbor Bay and others from Harvey Cedars.

Another marine cat fish, *Hexanemichthys felis* (Linnaeus), which may occur on the coast, has never yet been definitely recorded.

*Galeichthys marinus* De Kay, N. Y. Fauna, Zoöl. Fishes, III, 1842, p. 178.

*Ailurichthys marinus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 341.—Abbott, Geol. N. J., 1868, p. 826.

*Ælurichthys marinus* Bean, Bull. U. S. F. Com., VII, 1887, p. 150, from Baird.

### Genus AMEIURUS Rafinesque.

#### The Horned Pout.

#### Key to the species.

- |  |                     |
|--|---------------------|
| a. Caudal forked or deeply emarginate. | CATUS               |
| aa. Caudal rounded.                    |                     |
| b. Mental barbels white.               | NATALIS PROTHISTIUS |
| bb. Mental barbels all dusky.          | NEBULOSUS           |

#### **Ameiurus catus** (Linnaeus).

White Cat Fish. Cat Fish. Big Cat Fish. River Cat Fish.

Head  $4\frac{1}{2}$ ; D. 7; A. 22; P. 11; V. 8; caudal 10; branchiostegals 10. Body wide anteriorly, compressed posteriorly. Back elevated. Head widened, flattened. Eyes prominent. A pair of nasal barbels, and 4 mandibulars. Teeth in jaws small, moveable, cardiform, with slender curved tips. Anterior nostrils somewhat tubular, posterior linear. Skin smooth. First dorsal somewhat elevated and rounded. Second dorsal adipose. Anal long, rounded. Caudal deeply emarginate, lobes rounded. Pectoral small. Ventral very small. First ray of dorsal and pectoral strongly osseous, with denticles, and hidden in skin. All fins very thick. Color grayish-white, sometimes coppery, and a little more colored upon the back with tints of gray. Fins of a reddish color, adipose fin brownish. Iris yellowish-green. Length 15 inches. Delaware River. (Le Sueur.)

Very abundant in the Delaware and met with in most of its lower tributaries. The largest examples I have seen were taken in the main course of the river, and frequently by shad fishermen in the spring. They are also taken in gill-nets. It is an important and valuable food-fish of excellent quality. In life they vary at times in color, some much darker and others lighter, but always with a beautiful glistening reflection over most of the body. Occasionally examples have been seen with cloudings or with a somewhat marbled appearance. It resembles our other species, but may be distinguished at all times by the deeply emarginate tail.



White Cat Fish. *Ameiurus catus* (Linnæus).

*Amiurus catus* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 118.—Abbott, Nat. Rambles, 1885, p. 479.

*Pimelodus albidus* Le Sueur, Mém. Mus. Hist. Nat. Paris, V, 1819, p. 148.

*Amiurus albidus* Abbott, Geol. N. J., 1868, p. 826.

*Amiurus lynx* Abbott, Rep. U. S. F. Com., 1875-76, pp. 841, 843.

*Ameiurus natalis prosthistius* (Cope).

Cat Fish.

Head  $3\frac{3}{7}$ ; depth  $4\frac{1}{3}$ ; D. I, 6; A. III, 24; width of head  $1\frac{1}{4}$  in its length; snout  $2\frac{2}{3}$ ; eye  $9\frac{1}{3}$ ; width of mouth 2; interorbital space 2; dorsal spine 3; pectoral spine  $2\frac{3}{4}$ ; pectoral fin  $1\frac{1}{2}$ ;

ventral  $2\frac{1}{4}$ ; caudal  $1\frac{3}{7}$ ; least depth of caudal peduncle  $2\frac{1}{8}$ ; base of anal  $1\frac{1}{8}$ . Body rather elongate, compressed. Head depressed, profile broadly rounded when viewed above. Snout broad, depressed, and profile rounded. Eye small, elongate and anterior. Mouth broadly crescent-shaped with upper jaw protruding a little. Teeth fine, in rather broad bands in jaw. Maxillary barbel reaching near first third of pectoral. Outer mental barbel also longer than usual, and equals pectoral fin. Interorbital space broadly convex. Gill-rakers rather small, not numerous. Dorsal inserted about opposite tip of pectoral spine. Adipose fin large, near last third of postdorsal space over posterior rays of anal. Anal inserted midway between origin of pectoral and base of caudal. Caudal rounded. Pectoral reaches  $\frac{2}{3}$  to ventral. Ventral inserted about midway in body just behind base of dorsal. Color black, belly soiled whitish. Mental barbel whitish, maxillary and nasal dark. Length 8 inches. Batsto River. Type (cotype) of *Amiurus prosthisti* Cope.

This cat fish is confined to the rather quiet cedar-stained streams flowing into the Atlantic, such as the Great Egg Harbor, Batsto and Wading Rivers. Besides the material of Cope, on which I have already reported, are 3 examples which I secured in the Wading River near Speedwell, Burlington County, April 30th, 1904. In life they were deep blackish-olivaceous, except on the lower or ventral regions of head and abdomen, which were white. Mandibular barbels white. Ends of maxillary barbels whitish, otherwise black like nasal barbels. Fins black, bases of pectoral and ventral paler. Iris dull yellow. These were taken on a hook baited with raw pork during the evening. In the same locality as many as 25 were said to have been taken during a single evening, and occasionally large examples are reported from the larger and deeper bodies of water. They apparently seek concealment in the deep pools during the day, only taking the hook at dusk or after dark. I have never seen them swimming about. Their flesh is said to be good and held in some estimation as a food-fish by the farmers.

*Amiurus prosthisti* Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132.—Cope, Am. Nat., XXX, 1896, p. 943.

*Amiurus prosthisti* Fowler, Proc. Acad. Nat. Sci. Phila., 1900, p. 352.

*Amiurus natalis* Bean, Bull. U. S. F. Com., VII, 1887, p. 150.

*Ameiurus erebennus* Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, I, 1896, p. 139, reference in part.

***Ameiurus nebulosus* (Le Sueur).**

Cat Fish. Yellow Cat Fish. Mud Cat Fish. Horned Pout.  
Bull Head. Miller's Thumb. Stone Cat Fish. Black  
Cat Fish. Common Bull Head.

Head  $3\frac{1}{4}$ ; depth  $3\frac{1}{2}$ ; D. I, 6; A. IV, 19; width of head  $1\frac{1}{3}$  in



Yellow Cat Fish. *Ameiurus nebulosus* (Le Sueur).

its length; snout  $2\frac{3}{5}$ ; eye 10; width of mouth  $1\frac{2}{3}$ ; interorbital space 2; dorsal spine 3; pectoral fin  $2\frac{1}{6}$ ; ventral 2; base of anal  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{7}{8}$ ; caudal  $1\frac{3}{4}$ . Body elongate, compressed, deep anteriorly. Caudal peduncle deep, much compressed. Head large, wide. Eye small. Mouth large. Upper jaw slightly protruding. Teeth fine, in broad bands in jaws, that in front of upper jaw convex in front. Interorbital space flattened and broad. Maxillary barbels shorter than head and reaching gill-opening. Outer mental barbel longer than inner, about an eye-diameter less than interorbital space, and nasal barbel about same as inner mental. Rakers 3 + 10 short stout points. Dorsal inserted about midway between tip of snout and begin-

ning of adipose fin, which latter is over posterior base of anal. Anal begins about midway between origin of pectoral and base of caudal. Caudal broad, rounded. Pectoral reaching about  $\frac{3}{5}$  to ventral, which is inserted close behind base of dorsal and reaches beyond origin of anal. Color deep dark olive-brown, sometimes with distinct yellowish shades and again nearly black. Length 15 inches. Great Egg Harbor River at May's Landing.

Very abundant in the tide-water of the above, and they were reported above the dam, some said to have been thrown in from below. The largest run about 3 pounds. The adult female accompanies the numerous young of an inch or so in length, which swim about in a good-sized school. They have been seen thus frequently above the parent, who were more or less concealed. Upon a signal, such as a sudden swish of her tail or other motion, the young would all instantly sink for better concealment out of view. All of the Egg Harbor examples which I have examined were very dark in color, though variation in the amount of dull gamboge-olive tints on the sides of some was noted. Many were however nearly grayish, inclining to blackish or whitish. They are shipped in rather large quantities from this place by the fishermen, who receive about 3 cents a piece, to the markets of Philadelphia. All are caught on the hook and kept in live-boxes till shipped. At Cape May they do not appear so abundant, probably not more than a dozen are taken during a season, and not running much over 2 pounds.

An adult example taken at Trenton was olivaceous-brown above during life, with dusky on back and brassy or golden on sides or flanks, and around under surface of head. Lower surface of head brassy, and also lower surface of body above anal fin. All barbels distinctly black. Iris dusky with a narrow circle of silvery-white encircling pupil. Fins all dusky. Adipose dorsal same. Caudal tinted with deep wine-color. Bases of caudal and anal tinted with translucent purplish or lavender. Examples 3 inches long do not differ materially. Some were altogether more olive and without the brassy reflections seen in the adult.

This, the commonest of our fishes, is abundant at least in all of the lower tributaries of the Delaware. It is also equally numerous

in the small streams and large creeks. Though a good food-fish, it is frequently held in low esteem on account of its habits as a scavenger. It is to be found in either clear or muddy water if still, either in tide-water or above, and frequently numerous about the mouths of sewers. Those found in the smaller streams, brooks and ponds are often smaller, and in the latter one may find them sometimes very abundant, or in large schools moving slowly along the bottom all closely herded together. They rest in the concavities of deep pools in this fashion, and it is seldom that a net fails to dislodge a number of them.

*Ameiurus nebulosus* Bean, Bull. Am. Mus. H., IX, 1897, p. 332.—Evermann, Recreation, April, 1902, p. 292.

*Amiurus dekayi* Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 95.—Abbott, Geol. N. J., 1868, p. 826.—Abbott, Am. Nat., IV, 1870, pp. 386, 390.

*Amiurus atrarius* Abbott, Geol. N. J., 1868, p. 826.

### Genus SCHILBEODES Bleeker.

#### The Mad Toms.

#### Key to the species.

- |   |          |
|---|----------|
| a. Body rather short and thick; depth 4 to $5\frac{1}{2}$ ; fins uniform. | GYRINUS  |
| aa. Body elongate; depth about 6; fins with dark margins.                 | INSIGNIS |

#### *Schilbeodes gyrinus* (Mitchill).

Stone Cat. Little Cat Fish. Poison Cat Fish. Mud Cat Fish.

Head  $3\frac{3}{4}$ ; depth  $5\frac{3}{7}$ ; D. I, 7, 1; A. III, 13, 1; width of head  $1\frac{1}{4}$  in its length; snout  $2\frac{4}{5}$ ; eye 6; width of mouth 2; inter-orbital space  $2\frac{1}{3}$ ; third dorsal ray 2; fourth branched anal ray  $2\frac{1}{4}$ ; caudal  $1\frac{1}{3}$ ; pectoral  $1\frac{3}{5}$ ; ventral  $2\frac{1}{3}$ ; least depth of caudal peduncle  $2\frac{1}{15}$ . Body comparatively short, deep and robust. Head large, depressed. Snout short, broad and depressed. Eye a little longer than deep, a little anterior. Mouth broad, with broad fleshy lips. Upper jaw projecting a little. Teeth fine, pointed, in bands in jaws. Maxillary barbel reaching axil of

pectoral spine. Nasal barbel reaching posterior margin of orbit. Outer mental barbel but little shorter than maxillary, and inner mental barbel half way to origin of pectoral. Interorbital space broad, depressed. Gill-rakers  $3 + 8$ , lanceolate, and longest equals pupil. Origin of spinous anal about midway between tip of snout and middle of base of anal, and spine  $\frac{3}{5}$  of longest dorsal ray. Anal inserted midway between origin of pectoral and base of caudal. Caudal rounded, with many rudimentary rays. Pectoral reaching opposite origin of second dorsal ray, and spine reaching opposite origin of dorsal spine. Ventral inserted just behind base of last dorsal ray and reaching vent, close in front of anal. Color uniform dusky-brown, and fins mostly with pale dusky. Iris pale slaty. Length 5 inches. Crosswicks Creek near Trenton.

Very abundant in the tributaries of the Delaware, either in or above tide-water. The living fish is brown, which, together with the absence of dark edges to the fins and the usually deeper or more robust body, will at once distinguish it from the following species. It is also apparently more abundant, though both are found associated. They like the concealment of long grass, or such as may be afforded by weedy pools, especially when in direct communication with larger bodies of water. It does not reach so large a size as *Schilbeodes insignis*, and I have not taken examples above 5 inches in length. The young are like the adults, and are distinguished from the young of *Schilbeodes insignis* in the same manner. These small cat fish are dangerous to handle, as their small spines are capable of inflicting painful wounds. The pectoral spines are also furnished with a poison apparatus to increase distress. I have a small example which was said to have been found on a window after a storm during the spring of 1873. Prof. Ulric Dahlgren has found it near Trenton.

*Noturus gyrinus* Abbott, Am. Nat., IV, 1870, p. 718.—Abbott, Nat. Rambles, 1885, p. 479.

*Schilbeodes gyrinus* E. Smith, Trans. Linn. Soc. N. Y., IX, 1897, p. 20.



*Schilbeodes insignis* (Richardson).

PLATE 15.

Mud Cat Fish. Poison Cat Fish. Stone Cat.

Head 4; depth  $6\frac{1}{6}$ ; D. I, 6; A. III, 13; width of head  $1\frac{1}{4}$  in its length; snout  $2\frac{3}{4}$ ; eye  $5\frac{1}{4}$ ; width of mouth  $2\frac{1}{4}$ ; interorbital space  $2\frac{2}{3}$ ; third dorsal ray  $1\frac{3}{4}$ ; third developed anal ray 2; caudal  $1\frac{1}{3}$ ; pectoral  $1\frac{2}{7}$ ; ventral 2; pectoral spine 2; dorsal spine 3; least depth of caudal peduncle 2. Body rather long. Head broad, depressed, flattened in front. Snout a little broad and depressed. Eye a little elongate, anterior. Upper jaw projecting a little. Teeth fine, pointed, in bands in jaws. Maxillary barbel reaching axil of pectoral spine. Nasal barbel extending about an eye-diameter beyond posterior margin of orbit. Outer mental barbel a little shorter than maxillary, and inner reaching half way to origin of pectoral. Interorbital space broad and flat. Gill-rakers  $2 + 7$ , lanceolate, and longest about equals pupil. Origin of spinous dorsal about midway between tip of snout and first third of base of anal. Anal inserted midway between base of caudal and origin of pectoral. Caudal rounded, with many rudimentary rays. Pectoral reaching about opposite base of fourth dorsal ray, and its spine about opposite base of dorsal spine. Ventral inserted about opposite base of last dorsal ray and reaching about  $\frac{4}{5}$  of space to anal. Color brown, belly and lower surface of head paler. Vertical fins all with dusky margins. Length  $3\frac{1}{2}$  inches. Crosswicks Creek, near Trenton.

This species attains a larger size than the preceding and appears to be less abundant. Large examples of 10 inches in length are, however, rare. It is not distinguished from *Schilbeodes gyrimus* by most fishermen, who usually regard all small cat fish as the young of the larger individuals of *Ameiurus*. The coloration of this fish is a little paler than that of the preceding species, from which it may be told chiefly by its dark-edged vertical fins and more slender body. The only New Jersey examples I have were taken in Crosswicks Creek, near Trenton, where I found the species rather rare.

## Order HAPLOMI.

### The Pike Like Fishes.

In some respects this group is intermediate between the Isospondylous and spiny rayed fishes. Mostly in fresh-water, and some forms are remnants of an ancient fauna.

#### *Key to the families.*

- a.* Lateral margin of upper jaw formed by maxillaries; premaxillaries not protractile.
- b.* Teeth cardiform, unequal; jaws depressed and produced. ESOCIDÆ
- bb.* Teeth villiform; jaws equal, not produced. UMBRIDÆ
- aa.* Lateral margin of upper jaw formed by premaxillaries; premaxillaries extremely protractile. PÆCILIDÆ

## Family ESOCIDÆ.

### The Pikes.

Body elongate, not elevated, more or less compressed posteriorly, broad anteriorly. Head long. Snout prolonged and depressed. Mouth large, its cleft forming about half length of head. Upper jaw not protractile, most of its margin formed by maxillaries, which are quite long and provided with a supplemental bone. Lower jaw the longer. Premaxillaries, vomer and palatines with broad bands of strong cardiform teeth which are more or less movable. Lower jaw of strong teeth of different sizes. Tongue with a band of small teeth. No barbels. Gill-openings very wide. Gill-membranes separate, free from isthmus. Gill-rakers tubercle-like. Pseudobranchiæ glandular, hidden. Branchiostegals 12 to 20. Stomach not cœcal, without pyloric appendages. Air-vessel simple. Basis cranii simple. Head naked above. Checks and opercles more or less scaly. Scales small. Lateral line weak, obsolete in young specimens and developed in adult. Dorsal posterior, opposite and similar to anal. No adipose fin. Caudal fin emarginate. Pectoral fins small, inserted low. Ventrals rather posterior.

A single genus of fresh-water fishes reaching some size and of value as food. Their flesh is excellent, being white and flaky and of delicate flavor. The pike is noted for its voracity, aptly quoted from Thoreau as "mere machines for the assimilation of other organisms." Two species within our limits.

### Genus *Esox* Linnæus.

#### The Pikes.

#### *Key to the species.*

- a. Eye nearer tip of mandible than edge of gill-opening; scales 105 to 108;  
branchiostegals 11 to 13. AMERICANUS  
aa. Eye midway in head; scales 125; branchiostegals 14 to 16. RETICULATUS

#### *Esox americanus* (Gmelin).

Pike. Pickerel. Ditch Pike. Short Billed Pike. Mud Pike.  
Banded Pickerel.

Head  $3\frac{1}{6}$ ; depth  $5\frac{2}{3}$ ; D. v, 12; A. v, 11, 1; scales 105 in lateral line to base of caudal; 12 scales between origin of dorsal and lateral line; 11 scales between lateral line and origin of anal; mandible 2 in head; fourth developed dorsal ray  $2\frac{2}{5}$ ; fifth developed anal ray  $2\frac{3}{4}$ ; lower caudal lobe  $1\frac{7}{8}$ ; least depth of caudal peduncle  $4\frac{2}{3}$ ; pectoral  $2\frac{1}{2}$ ; ventral  $2\frac{3}{5}$ ; snout  $2\frac{3}{5}$  in head measured from tip of upper jaw; eye 7; maxillary a trifle less than 2; interorbital space 5; branchiostegals 13. Body elongate, compressed and rather robust. Head heavy, compressed posteriorly. Snout rather broad, depressed, and maxillaries protruding laterally. Eye high, a little anterior, and a little longer than deep. Mandible protruding a little beyond tip of upper jaw. Maxillary not quite reaching posterior margin of pupil. Teeth moderately large, those in front of upper jaw and several along side of each ramus of mandible a little enlarged. Teeth on tongue minute. Nostrils similar, rather large, close together in last third of snout. Interorbital space flat. Side of mandible with a broad thin labial fold. Gill-rakers as a series of very fine or minute asperities. Scales small, smaller on breast and at bases

of vertical fins, those on caudal very fine and crowded. Cheek, opercle and upper branchiostegals scaly, rest of head naked. Lateral line rather obscure, complete, of simple tubes. Dorsal inserted a little nearer origin of ventral than base of caudal, median rays highest. Anal inserted a trifle before origin of dorsal and similar. Caudal emarginate. Pectoral a trifle more than half way to ventral. Ventral inserted a little nearer origin of anal than that of pectoral. Color dark greenish-olive on back, lower surface whitish. About 20 abrupt distinct blackish curved bands on side, not reticulated. A dark bar from snout through eye to opercle, and another from below eye over cheek. Length  $10\frac{1}{8}$  inches. Crosswicks Creek at Trenton.

In life pale or dull olive-brown above, marked everywhere with brownish dusky. Upper surface with golden and bronze reflections, in some lights coppery. Side with indistinct dusky lines sloping down forward. Lower surface white. A blackish line from tip of snout to eye and continued behind opercle above. A blackish streak from lower margin of eye down across cheek. Lips shaded with dusky. Fins all dull orange-red, dorsal and caudal shaded with dull dusky-olive. Iris brownish-olive-golden above and whitish below. A pale median streak from tip of snout to upper base of caudal. Several markings of dusky on side of head like those on flanks. Inside of gill-opening pearl-colored. Taken in Crosswicks Creek in June of 1904.

This species is the common one in most all of the waters of the state, occurring most everywhere, sometimes in shallow ditches and pools where its retreat is entirely cut off from other waters. It reaches a foot in length and is a good pan-fish. Unlike many of our other fishes they always remain perfectly motionless or stationary except for such motion as is required of their fins to keep them so. Frequently the glassy goggle-eye may be seen before the rest of the body is made out. When taken from the water alive they are among the most beautiful colored of all fishes but soon fade after death. The color-markings are very soft or diffuse, and the whole body is a perfect mass of shimmering rainbow reflections. They vary somewhat, and some I have seen were quite dark, though this could not have been due alto-

gether to the streams in which they were taken, as pale examples were taken at the same time and precisely in the same localities. During the winter months, when the ponds and creeks are frozen, it was not unusual to see them captured by striking the ice above a sharp blow with a hatchet, and then chop through and extract them before they have recovered from the effect of the concussion. Small boys often employed this method, and I have seen them with a dozen or more taken during a single afternoon in late winter and early spring. The flesh of this fish is of excellent quality. It is of rather small size, few examples exceeding a foot in length. The young are paler and without the rich coloring of large examples, usually more or less pale hyaline-green with very pale markings. They have the same voracious habits, however.

So far as I can learn no pike have been taken in Lily Lake at Cape May, though they were reported from Mill Pond, the next body of fresh-water of size to the north.

*Esox americanus* Jordan, An. N. Y. Acad. Sci., T, 1879, p. 104.—Bean, Bull. U. S. F. Com., VI, 1887, p. 147, from Baird.

*Lucius americanus* Evermann, Recreation, April, 1902, p. 292.

*Esox fasciatus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 345.—Abbott, Geol. N. J., 1868, p. 822.—Abbott, Rep. U. S. F. Com., 1875-76, p. 844.—Abbott, Nat. Rambles, 1885, p. 478.

*Esox porosus* Abbott, Geol. N. J., 1868 (1869), p. 822.—Abbott, Am. Nat., IV, 1870, p. 386.—Abbott, Rep. U. S. F. Com., 1875-76, p. 844

*Esox umbrosus* Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132.

*Esox vermiculatus* Cope, Am. Nat., XXX, 1896, p. 943.

#### ***Esox reticulatus* Le Sueur.**

Pike. Chain Pickerel. Pickerel. Common Eastern Pickerel.

Head  $2\frac{9}{10}$ ; depth 6; D. v, 12, 1; A. v, 11, 1; scales 115 in lateral line to base of caudal, and about 7 more on latter; about 42 tubes in median lateral line; 13 scales between origin of dorsal and lateral line; about 12 scales between origin of anal and

lateral line; mandible  $1^{15}/_{16}$  in head; fourth developed dorsal ray  $2^{2}/_{5}$ ; second developed anal ray  $2^{2}/_{5}$ ; lower caudal lobe  $1^{11}/_{12}$ ; least depth of caudal  $5^{1}/_{8}$ ; pectoral  $2^{3}/_{4}$ ; ventral  $2^{3}/_{4}$ ; snout  $2^{1}/_{4}$  in head measured from tip of upper jaw; eye 7; maxillary  $2^{1}/_{15}$ ; interorbital space  $5^{7}/_{8}$ ; branchiostegals 16. Body long, slender, compressed, deepest near middle and tapering back to a slender caudal peduncle. Head long, compressed posteriorly. Snout rather broad, depressed, and maxillaries protruding laterally. Eye high, a trifle posterior, and a little oval, narrower end anterior. Maxillary reaching front of orbit, but not quite to front rim of pupil. Teeth rather small, those in front of upper jaw and several along side of each ramus of mandible a little enlarged. Teeth on tongue minute. Nostrils similar, close together, rather large, and anterior about last third in snout. Interorbital space flat, a trifle concave medianly. Side of mandible with a broad thin labial fold. Gill-rakers as a series of very fine or minute asperities. Scales small, smaller on back medianly and base of caudal. Cheek and opercle scaly. Scattered tubes similar to those in lateral line above and below its course. Dorsal inserted about last four-nineteenths in head and trunk, median rays highest. Anal opposite and similar. Caudal emarginate. Pectoral about half way to ventral. Ventral inserted nearer origin of anal than that of pectoral. Color deep olive on back, below whitish. Sides with dark reticulating lines, mostly horizontal. A dark streak below eye. Length  $9^{5}/_{8}$  inches. Cedar Swamp Creek, in the Great Egg Harbor basin.

Color in life brown, peritoneum of abdomen showing through as purple and bluish. A median pale dusky streak from tip of snout to opercle, and a little posteriorly along side of trunk just above line of demarcation of color. A median pale streak down back from tip of snout to dorsal. Black line on side of head also continued on side of head across iris. Iris white, chrome above. Margins of jaws dusky. Lower surface of head pale translucent brown. Thorax and opercular region with ruddy-purple reflections. Region from ventral to anal narrowly and medianly with slight silvery reflections showing through. Fins pale brown with dull dusky shades. Length  $1^{1}/_{2}$  inches. Another example 6

inches long had fins tinted with deep red in life, pectoral and ventral more or less of an orange shade. A pale golden stripe from orbit to base of caudal, dark lines reticulating above and below, and in between with dusky markings. Upper surface and back dusky-olivaceous, dorsal, anal and caudal with same ground-color. Side of body translucent greenish or olivaceous. Belly and ventral surface white with just a tint of translucent greenish. Inside of gill-opening with golden and red reflections. Opercle with brassy reflections and tinted with golden. Iris brown, greenish below. A black line below orbit across cheek. Found with *Umbra*. The young were abundant in the sphagnum. Though a little active they were much less so than the adults. The latter were frequently found in small ditches without any advantageous



Chain Pickerel. *Esox reticulatus* Le Sueur.

opportunity for escape except hiding in the vegetation, about which they would quickly dart when pursued, though invariably resting a short time after each effort. Their colors were also seen to harmonize with their surroundings. All from Wading River at Speedwell, April 30th, 1904. This species is reported to occur in the Great Egg Harbor River.

This is our largest species, reaching a length of 2 feet.

*Esox reticulatus* Le Sueur, Journ. Acad. Nat. Sci. Phila., 1818, p. 414.—Baird, 9th An. Rep. Smiths. Inst., 1854, p. 346.—Abbott, Geol. N. J., 1868, p. 822.—Abbott, Am. Nat., IV, 1870, p. 104.—Abbott, Rep. U. S. F. Com., 1875-76, p. 845.—Jordan, An. N. Y. Acad. Sci., T, 1879, p. 104.—Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132.—Abbott, Nat Rambles, 1885, p. 478.—Bean, Bull. U. S. F. Com., VII, 1887, p. 147, Pl. I, fig. 17.

*Lucius reticulatus* Bean, Bull. Am. Mus. N. H., IX, 1897, p. 352.—Evermann, Recreation, April, 1902, p. 292.

### Family UMBRIDÆ.

#### The Mud Minnows.

Body oblong, broad anteriorly, compressed behind. Head large, flattened above. Mouth moderate, with bands of villiform or cardiform teeth on premaxillaries, lower jaw, vomer and palatines. Premaxillaries not protractile. Lateral margin of upper jaw formed by broad short maxillaries which are toothless and without distinct supplemental bone. Lower jaw longer. Gill-openings wide, membranes scarcely connected. Gill-rakers little developed. Pseudobranchiæ hidden, glandular. Branchiostegals 6 to 8. Stomach without blind sac. No pyloric cæca. Air-vessel simple. Oviparous, sexes similar. Scales moderate, cycloid, covering head and body. Lateral line wanting. Dorsal fin moderate, posterior, in advance of anal. Caudal rounded. Pectorals inserted low. Ventrals small, close to anal.

Small carnivorous fishes, extremely tenacious of life. They live among weeds, or more usually in mud, at the bottom of sluggish streams or ponds. They differ from the *Esocidæ* chiefly in the smaller mouth and weaker teeth. Like *Aphredoderus* and other associated American fresh-water forms, *Umbra* must be regarded as an archaic type characteristic of some earlier fish-fauna. A single genus and species in the state.

#### Genus UMBRA Müller.

#### *Umbra pygmæa* (De Kay).

#### PLATE 16.

#### Mud Minnow. Mud Fish.

Head  $3\frac{2}{5}$ ; depth 4; D. II, 12; A. III, 6; scales 30 in a lateral series to base of caudal and 3 more on latter; 13 scales between origin of dorsal and that of ventral; about 25 scales before dor-



sal; first branched dorsal ray  $1\frac{5}{6}$  in head; first branched anal ray  $1\frac{2}{3}$ ; caudal  $1\frac{1}{8}$ ; least depth of caudal peduncle  $1\frac{4}{5}$ ; pectoral  $1\frac{3}{4}$ ; ventral  $1\frac{3}{4}$ ; snout  $4\frac{1}{3}$  in head measured from tip of upper jaw; eye  $4\frac{2}{5}$ ; maxillary  $3\frac{1}{4}$ ; interorbital space 4. Body robust, rather thick or but little compressed. Caudal peduncle very deep, compressed, and its length about four-fifths its least depth. Head rather bluntly conic. Muzzle rather broad, snout short and convex. Eye circular and about first third in head. Mouth broad, rather short and little inclined. Mandible protruding a little beyond tip of upper jaw. Maxillary oblique, about reaching front margin of pupil and its greatest expansion about equal to diameter of same. Teeth small in jaws. Nostrils well separated, anterior midway in snout, and posterior higher, close to eye. Interorbital space broad, only slightly elevated, and flattened. Gill-rakers  $5 + 10$ , short and thick. Scales large, smaller on base of caudal. Dorsal inserted nearer origin of pectoral than base of caudal. Anal inserted midway between tip of pectoral and base of caudal, when depressed its tip reaching latter. Caudal broad and rounded. Pectoral broad and rounded, about three-fifths of space to ventral. Ventral inserted just before origin of dorsal, and depressed reaches base of third anal ray. Dark olive-brown. About a dozen narrow dark longitudinal bands, widest and most distinct on upper surface of body. A dark bar from snout and continued back from eye on side of head above. A dark vertical bar at base of caudal. Length  $3\frac{3}{8}$  inches. Batsto River.

Color in life deep olivaceous-dusky, back very dark. Belly and under surface of body opaque white. Lower side dull olivaceous. In lateral line a pale or light spot on each scale. An indistinct dusky diffuse longitudinal band from tip of snout to base of caudal. Indistinct narrow longitudinal lines about parallel on side of back, most distinct anteriorly, and in color of pale olivaceous. Traces of similar ones on lower side, and with a number of <-shaped markings similar to those in lateral line scattered about longitudinally though unevenly. Dorsal and caudal deep olive-dusky. Anal paler. Ventral and pectoral dull olivaceous tinted with dull saffron. A pale streak from eye to gill-opening

with a somewhat ruddy reflection. Cheek and opercle with brassy, ruddy and olivaceous reflections. Lips dusky. Inside of gill-opening with grayish-dusky. A black blotch at base of caudal. Iris brown. Length  $2\frac{1}{2}$  inches. A young example about  $1\frac{1}{2}$  inches in length had the following colors in life. More uniform olivaceous, each scale with an apparent dark edge. Base of caudal with a black spot transversely. Pectoral, ventral and anal pale or translucent brown. Each pale spot in lateral line distinct. Peritoneum not showing through body-walls as plainly as in large example. Longitudinal blackish line only distinct on head and in costal region. Lower surface of body translucent brownish. Side of head variegated with dull dusky horizontally directed lines. Lower surface of head pale translucent brownish. Another example of intermediate size was colored as follows during life. Head beautifully variegated with metallic hues of golden or reddish. One of latter follows lower margin of preorbital, below orbit, on back from lower margin of eye to opercular blotch, and with margin pinkish-golden. A similar line from upper margin of orbit back to beginning of lateral line. Subopercle with a lilac hue. A transverse or vertical black band continued below eye across cheek. Iris reddish hued. Thorax with greenish and golden tints. Lower side of body, especially posteriorly, with many dull lilac-purple spots. Soft dorsal, anal and caudal with numerous pale brown spots. Pectoral pale olive-brown, tinted rather deeply with dark brassy, axil blackish. Ventral with lower margin pale bluish, first three rays dusky, especially distally. Bases of dorsal, anal and caudal with olivaceous tints. All from the Wading River near Speedwell in April of 1904.

Abundant, and found at most all times of the year. They appear to me most abundant during the summer months, when they have been taken in clear, deep water with muddy bottoms and also in the long eel-grass. It is more common, however, to take them in shallow pools of clear water that have a deep bottom of soft mud. In such places they remain altogether concealed, but may easily be scooped out with the mud. They vary considerably with the locality, some of those of the cedar-stained waters being much darker than those of paler waters or clear streams.

The fish also have a certain amount of power to change their color. Those in aquaria will thus be seen to fade or grow darker to a considerable degree at times. In the Wading River they were found only in the sphagnum growing along the banks in the more sheltered places, or away from the currents. Here they may be taken in a small dip-net. They wriggle continually, or suddenly remain quiet for a short interval, the small ones in this respect strongly suggesting the dusky salamander (*Desmognathus fusca*). The resemblance is still further suggested by their similar dark color. In fact, the extremely dark color, almost blackish, was noticeable in all the examples caught, though of course the notes above will show the various tints assumed when out of the water and dying.

*Melanura pygmæa* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 342.—Jordan, An. N. Y. Acad. Sci., T, 1879, p. 104.

*Umbra pygmæa* Bean, Bull. U. S. F. Com., VII, 1887, p. 147.—Cope, Am. Nat., XXX, 1896, p. 943.

*Melanura annulata* Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 95.

*Melanura limi* Abbott, Geol. N. J., 1868, p. 820.—Abbott, Am. Nat., IV, 1870, p. 107.—Abbott, l. c., pp. 386, 388.—Abbott, Rep. U. S. F. Com., 1875-76, p. 845.

*Umbra limi* Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132.—Abbott, Nat. Rambles, 1885, p. 478.

### Family PÆCILIIDÆ.

#### The Killi Fishes.

Body oblong or moderately elongate, compressed behind, depressed forward. Head usually broad. Mouth terminal, small, lower jaw usually projecting and margin of upper formed by premaxillaries only. Premaxillaries strong and extremely protractile. Teeth incisor-like or villiform, sometimes present on vomer, but usually in jaws only. Gill-membranes somewhat connected, free from isthmus. Gill-rakers very short, thick. Pseudobranchiæ none. Branchiostegals 4 to 6. Lower pharyngeals separate, with cardiform, or rarely molar, teeth. Third upper

pharyngeal enlarged, and fourth wanting or united to third. Stomach siphonal, without pyloric appendages. Air-vessel simple, often wanting. Basis cranii simple. Sexes usually unlike, fins largest in males, but in some species females are much larger in size. Many are ovoviviparous, the young well developed at time of birth. In these species sexes are very unlike, the anal fin of male developed as an intromittent organ. Body covered with rather large cycloid scales, which are adherent and regularly arranged. Head scaly, at least above. Lateral line wanting or represented by a few imperfect pores. Dorsal fin single, inserted posteriorly, of soft rays only or rarely with a single spine or rudimentary spinous dorsal. No adipose fin. Caudal not forked. Pectorals inserted low. Ventrals abdominal, rarely wanting.

Mostly fresh-water fishes of small size, though some occur in the arms of the sea in warm regions, and difficult of determination.

### *Key to the genera.*

- a. FUNDULINÆ. Teeth all pointed, none compressed, bicuspid or tricuspid.
  - b. Teeth in villiform bands or in at least one or more series.
    - c. Origin of dorsal before that of anal, radii 11 to 17. FUNDULUS
    - cc. Origin of dorsal behind that of anal, radii 7 to 11. ZYCONECTES
  - bb. Teeth uniserial; origin of dorsal before that of anal; mouth oblique. LUCANIA
- aa. CYPRINODONTINÆ. Teeth incisor-like, notched, bicuspid or tricuspid. CYPRINODON

### Genus FUNDULUS Lacépède.

#### The Killi Fishes.

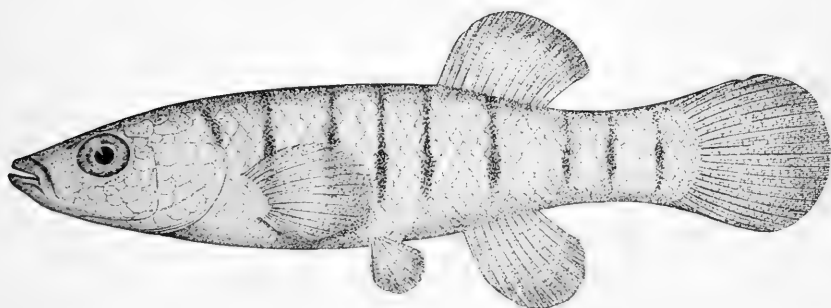
### *Key to the species.*

- a. Scales large, 31 to 38 in a lengthwise series.
  - b. Female with 2 or 3 black horizontal stripes; male with about 12 dark cross-bars and a dorsal ocellus; branchiostegals 6. MAJALIS
  - bb. Females nearly plain; males with many pearly spots, and dorsal ocellus faint or wanting; branchiostegals 5. HETEROCLITUS MACROLEPIDOTUS
- aa. Scales small, 44 to 60 in lateral line. DIAPHANUS

**Fundulus majalis** (Walbaum).

Minnow. Killi Fish. May Fish.

Head  $3\frac{1}{6}$ ; depth 4; D. III, 10; A. III, 8; scales 35 in a lateral series to base of caudal and 3 more on latter; 15 scales between origin of dorsal and that of anal; 23 scales before dorsal; first branched dorsal ray  $1\frac{5}{6}$  in head; second branched anal ray  $1\frac{1}{6}$ ; caudal  $1\frac{1}{3}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $2\frac{1}{8}$ ; least depth of caudal peduncle  $2\frac{1}{6}$ ; snout  $3\frac{1}{3}$  in head measured from tip of upper jaw; eye  $5\frac{1}{4}$ ; maxillary  $3\frac{3}{4}$ ; interorbital space 3. Body rather long, hardly elevated, and little compressed. Caudal peduncle deep and compressed. Head attenuate in profile, flattened or

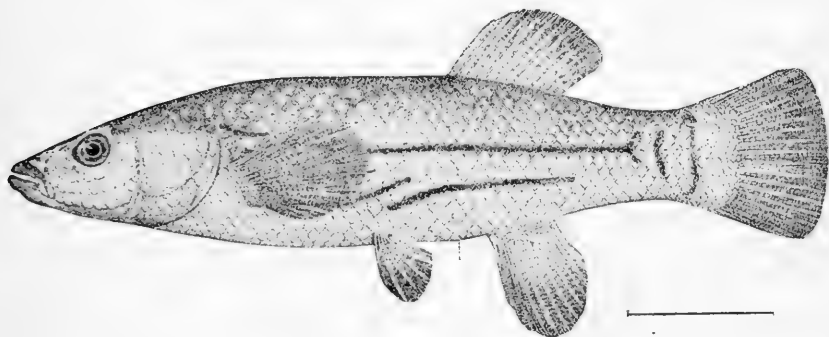
May Fish. *Fundulus majalis* (Walbaum). (Young.)

depressed above. Snout long, depressed. Eye small, circular, high, and near first  $\frac{2}{5}$  in length of head. Mouth small, very protractile, and mandible projecting in front. Teeth fine, in bands in jaws. Nostril close to front of eye above. Interorbital space broad and flat. Gill-rakers 6 short fleshy points on first arch. Scales large, especially those on top of head, and others becoming reduced on base of caudal. Origin of dorsal nearer that of pectoral than base of caudal, and all branched radii highest and subequal. Anal begins a trifle behind origin of dorsal, its depressed tip reaching further than that of dorsal, though not quite opposite base of caudal, and third ray longest. Caudal rounded. Pectoral short and rounded, reaching ventral. Ventral inserted

well before dorsal or nearer origin of anal than that of pectoral, and reaching beyond first few anal rays. Color dark olivaceous on upper surface. A black blotch on dorsal midway in height on last 4 rays. Sides with about 8 well defined vertical dusky or leaden streaks, between each also a shorter or obsolete one. Fins pale, lower yellowish. Length  $3\frac{5}{8}$  inches. From the surf at Stone Harbor. A female with the same data shows: Head 3; depth  $3\frac{7}{8}$ ; D. III, 12; A. II, 9; scales 37 in a lateral series to base of caudal and 4 more on latter; 15 scales between dorsal and anal; snout  $3\frac{1}{8}$  in head, measured from tip of upper jaw; eye 5; maxillary  $3\frac{1}{2}$ ; interorbital space  $2\frac{4}{5}$ . Coloration similar to male in preserved example. There is a single dark vertical bar at base of caudal, a dark longitudinal line from shoulder till just in front of caudal bar with another obscure or broken bar parallel and below. Length  $2\frac{5}{8}$  inches.

Color in life with upper surface of head and back olivaceous-gray-brown, former darker and all laterally with reflections of beautiful translucent brassy. Margins of each scale on back beautiful algæ-green above, dotted more or less with dusky along middle of side. Lower lip dusky. A narrow line from above opercle to middle of caudal peduncle anteriorly till about middle of its length, and afterwards 3 vertical cross-bars of a similar color. Below longitudinal line another similarly parallel, extending from upper base of pectoral, where it is more or less indistinct, and along lower side of body above bases of anal and ventral, where it is distinct. Not entire on right side. Upper side of caudal peduncle with several dusky-olivaceous diffuse shadings. Dorsal and caudal pale grayish-olive, base of latter a trifle more deeply tinted with a shade of greenish. Pectoral, ventral and anal pale or dilute translucent grayish-white, more or less tinged with olivaceous-yellow and former with a few dusky dots above. Lower surface of body opaque white with silvery reflections. Iris a beautiful brownish. Other examples with vertical stripes were deep olivaceous-dusky above, top of head and median line of back darker. Mandible and lobes more or less olivaceous. Cheek with golden-olivaceous reflections. Each scale of upper surface margined with dusky olivaceous-

green, extending down on middle of sides in a connected series of spots along margin of each scale. About 17 transverse dusky slate-colored lines, rather narrow, not extending on back or on lower ventral region, of about equal width and similar anteriorly, but becoming alternately more pronounced posteriorly. A greenish spot above and at origin of pectoral and dorsal, fins dusky, with a deep slaty-dusky spot on middle of last 2 rays. Caudal dusky, basally with an amber shade, and becoming more or less greenish on bases of rays. Pectoral pale or dilute ochraceous-white, somewhat olivaceous above. Ventral dilute creamy-white. Anal white with a translucent tinge of amber. Under surface of head and body opaque white with a silvery tint. Iris brown. Examples  $2\frac{1}{2}$  to 3 inches in length have upper surface of head



May Fish. *Fundulus majalis* (Walbaum). (Female.)

and body brownish-olive, darker on top of head and median line of back, especially anteriorly. Side of head and body slightly paler brown, with about 2 narrow metallic bottle-green vertical lines above. Below same becoming blue or purplish-bottle-green color and all reflected, also passing well down on ventral region. All of lower ventral region translucent brownish with a median dusky streak. Opercle with beautiful olivaceous or golden-greenish reflections. Lore and interopercle with bottle-purplish-blue reflections. Peritoneum in abdominal region showing through as opaque translucent white. Mandible and jaws pale brownish. In front of base of pectoral metallic bluish. Dorsal and caudal brownish-olivaceous. Pectoral pale olive, slightly tinted with

dusky. Anal translucent brownish, tinted with pale dusky dots. Ventral translucent brownish-white. Inside of gill-opening whitish with a greenish-olivaceous blotch specked with brownish. Iris brownish. Cape May in April, 1904.

In the inlets and small brackish-water streams on the meadows, this species, together with the next and *Menidia menidia notata*, run in with the tide. Sometimes other small fish also go with them, though *Fundulus* is always the most abundant. It swims in rather large schools, usually a hundred or more, and if one approaches in a boat they make a great commotion in the shallow water along the banks, especially the larger ones, which are apt to become stranded on the mud. In some pools which dry up many perish and their parched bodies may be seen in numbers. Thousands of living examples were examined. About Cape May they were abundant, associated with the above mentioned fishes, together with *Lucania* and *Cyprinodon*, though not many were taken in the surf. Many perish in the freezing weather and are then eagerly devoured by gulls. They take the hook readily when baited with an earth-worm. At Stone Harbor they were found abundant with *Menidia menidia notata* in the surf. At Cape May the females, while not so abundant as the males, were frequently seen. The females are marked very differently in color and may be distinguished at once by their several dark longitudinal stripes. Besides the above localities multitudes of examples were examined from Anglesea, Sea Isle City, Ocean City, Beesley's Point, Barnegat and Atlantic City.

*Hardrargyra majalis* Abbott, Geol. N. J., 1863, p. 820.

*Fundulus majalis* Bean, Bull. U. S. F. Com., VII, 1887, p. 147.

—Moore, Bull. U. S. F. Com., XII, 1892, p. 360.

*Hardrargira flavula* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 344.

*Fundulus heteroclitus macrolepidotus* (Walbaum).

PLATE 17.

Minnow. Dog Fish. Killy. Killie. Killy Fish. River Minnow.  
Mummichog. Blunt Head.

Head  $3\frac{1}{5}$ ; depth  $3\frac{2}{5}$ ; D. 11, 10; A. 1, 9; scales 33 in lateral line to base of caudal and 3 more on latter; 22 scales before



dorsal; 15 scales between origins of dorsal and anal; fifth dorsal ray  $1\frac{4}{5}$  in head; fifth branched anal ray  $1\frac{2}{5}$ ; caudal  $1\frac{2}{7}$ ; least depth of caudal peduncle 2; pectoral  $1\frac{2}{3}$ ; ventral  $2\frac{1}{3}$ ; snout  $3\frac{3}{5}$  in head, measured from tip of upper jaw; eye  $4\frac{2}{5}$ ; maxillary  $2\frac{2}{3}$ ; interorbital space  $2\frac{2}{5}$ . Body deep, compressed, rather short and robust, and back elevated. Caudal peduncle deep and compressed. Head large, blunt, broad and flattened above. Snout short, broad and flattened above. Eye a trifle longer than deep, and placed near first third of head. Mouth protractile, horizontal when closed, broad and short. Maxillary not reaching orbit. Teeth rather large in jaws, especially those on each side of mandible in outer series. Nostril close in front of eye above. Interorbital space broad and flat. Gill-rakers 10 rather short denticles graduated down from uppermost, which is longest. Scales large, those on top of head very large, and others becoming smaller on base of caudal. Scales on cheek in three series. Dorsal inserted nearer origin of pectoral than base of caudal, and branched rays highest and subequal in length. Anal inserted opposite origin of dorsal, fin triangular with fourth and fifth rays longest, forming point of triangle, and though reaching beyond tip of depressed dorsal not reaching base of caudal. Caudal rounded. Pectoral small, rounded, not quite reaching ventral. Ventral inserted nearer origin of anal than that of pectoral and reaching latter. Back deep or blackish-olive, belly orange-yellow. Sides with bars of whitish-silvery spots. Vertical fins dark spotted with whitish, margin of dorsal bright yellow. Pectoral with dusky, otherwise it, together with ventral and lower part, pale. Length  $3\frac{1}{2}$  inches. Cape May. This description from a male. A female with same data has: Head  $3\frac{1}{8}$ ; depth  $3\frac{2}{5}$ ; D. 1, 11; A. 1, 10; scales 36 in lateral series to base of caudal; 14 scales between origins of dorsal and anal; snout  $3\frac{1}{3}$  in head measured from tip of upper jaw; eye  $4\frac{1}{4}$ ; maxillary  $2\frac{1}{5}$ ; interorbital space  $2\frac{1}{8}$ . Color pale brownish, lower surface whitish. Length 4 inches.

Males 4 inches in length during life were olivaceous above, more or less uniform on sides, all of caudal peduncle and anal region. Anal, caudal and pectoral same color, except latter, which is margined with chrome-yellow. Lower surface of head and abdomen pale opaque greenish-white. Side of body

with traces of narrow indistinct vertical pale bars and broad and pale bluish bars, alternately pronounced in some examples, while indistinctly or almost obliterated in others. Side of body, especially posteriorly, with numerous irregular greenish-white specks, largest opposite ventral region and becoming small and numerous on entire caudal peduncle. Dorsal, caudal and anal somewhat blackish basally, and bases with similar colored dots, on bases of last dorsal rays a blackish area also mottled with same colored spots. Sides of caudal peduncle also mottled with darker ochraceous. Bases of caudal and anal also tinted blackish. Pectoral dilute brownish, tinted with dusky basally. Ventral pale yellowish tinted with dusky basally. Iris pale brownish. Pale purplish reflection on cheek, and dull brassy reflection on opercular region. Males vary a great deal, some have very few spots, and juvenile males have them only as broken bluish vertical transverse bands, remnants of alternate bluish bands seen in adults. They often have the peacock-eye of the dorsal very distinct. Pale examples 6 inches long, females, were brownish-olive above, darker or dusky on head and back above. Side grayish tinged, margin of each scale olivaceous, and with pale dusky dots. Cheek and opercle dusky-olivaceous with purplish reflections on lower surface of former, otherwise with more or less greenish. Jaws and mandible livid brownish with a median narrow yellow line on latter. Lower surface of head otherwise pale brownish of rather warm tint. Chest and abdomen translucent whitish, tinted with dull buff and with dull golden-brassy reflections. Lower surface of caudal peduncle translucent greenish-brown. Dorsal and caudal olivaceous-brown, base of latter deeper than margin in color. Pectoral olivaceous with a dull ochraceous-amber tinge, upper rays a little darker. Ventral and anal similar, only without dark, or rather pale. Iris brownish. Cape May, in April, 1904.

A male in life in the *ornatus* stage was dilute olive-brown on back and abdomen. Sides of head and anal fin tinted with lemon-yellow. Pectoral and ventral also the same tint, but ventral and anal brighter, and latter with pale brownish basally. Side of head with bronzed and pale greenish reflections. Dorsal with a blackish blotch, edged anteriorly with whitish, on posterior rays

medianly. Side with about a dozen or less vertical pale or dilute silvery narrow bars, crowded on costal region, and far apart on tail. Dorsal pale brownish margined with pale or whitish. Caudal pale brownish, and posterior margin dilute greenish. Iris dilute brassy. Crosswicks Creek near Trenton, N. J., May 9th, 1905. Very abundant in the shallow pools and runs on the flats. They appear very differently colored from the adults, many of which, all much larger, as to be expected, were taken with them. However, I did not notice any males deeply pigmented, or more or less blackish, like those taken at Cape May Point May 7th, 1905. An adult female in the *ornatus* stage, with the same data as the one described above was brownish in life. Scales on back with slightly brownish centers, and those on sides forming imbricated diamonds of fine blackish dots. A pale silvered reflection from above costal region to caudal. Peritoneum showing through abdominal walls whitish with little reflection. Fins translucent. Caudal brownish with a slightly ruddy tint. Dorsal with uniform dull brown. Pectoral, anal and ventral dilute brownish. Side of head, especially opercle, with brassy reflections, and cheek tinted with dull azure. Examples in both of the above described stages are found at all seasons of the year, equally common with the adult examples, which breed in the Delaware.

This interesting little fish was found in abundance May 7th, 1905, swimming in the lower waters of the small creek at Cape May Point. This stream flows directly into the salt water of the bay side. At its mouth but few of the fish occur, though thirty yards or so above they are abundant in numerous schools or shoals along the shallows of the banks, which are formed of sand. We did not notice them to any extent above these places or other than where the stream passes over the sandy beach. They were easily frightened into the deeper waters or channel by any sudden movement, though not at all disturbed by loud talking or other noise. Provided there is no movement on the banks one may watch them conduct their spawning for a long time. They do not remain in the channel long, but soon swim up in the shallows close to the shore, and often when the orgasm takes place they are more or less out of the water. The usual method is for a male to swim rather nervously alongside a female

and crowd her close on the shore, at the same time bending his body in a somewhat undulated fashion with the brilliant dorsal fin thrown over her back, and then with a rapid flapping of his tail, which produces a rippling sound in the water, the milt is apparently expelled. This operation lasts but several seconds, and sometimes the participants find themselves washed on shore, when there is a very hurried attempt to get back into the water. All along these banks we could hear these little rippings and see the fish wriggling back into the water. Sometimes copulation would take place entirely under the water on the little shoals. It did not appear that it was always necessary for these animals to have a projection or some support of a similar nature from the bottom to enable them to successfully accomplish their purpose. In fact, they would frequently fasten alongside one another on a perfectly smooth bottom, in which case the male would apparently crowd the female down. I was unable to determine the manner of coupling, if such takes place, of the organs of generation. Examples freshly caught would produce milt or ova, as the sex of the individual may be, if they were forced out by pressure on the abdomen with the thumb. The milt was purely white and milky. The ova was about the size of number 4 shot, translucent, and of a very pale brownish. No male organ of generation was noted. The female has the oviduct extending along the front of the anal fin nearly to its lower margin, and the ova could be forced through it only in regular sequence. When in the water the two sexes are readily recognized, as they are very distinctly marked. The males are blackish, and are decidedly black in contrast alongside the pale brownish females. Rather small males, of about 2 inches in length, display the dark and brilliant colors of the older ones. The females were frequently seen swimming to and fro over the shallows, suddenly inclining their bodies somewhat on the side so that their shining whitish abdomens may be readily seen. I did not determine whether the eggs were laid simply awaiting the initiative of the male. The intercourse between the sexes was in some cases I noted confined to a single pair, though mostly it seemed to be promiscuous. In fact, these animals seemed to have nearly unlimited powers of intercourse.

Abundant in the lower Delaware and along the coast. In tide-water they ascend the Delaware as far as Trenton at least. Age, sex and color play a great part in the variation of this little fish. About the mud flats they are frequently met with in large schools, often associated with *Fundulus diaphanus*, and sometimes with other small fishes, as *Enneacanthus gloriosus*, *Anguilla chrisypa*, *Umbra pygmæa*, *Brama crysoleucas*, young *Eupomotis*, *Lepomis*, *Morone*, *Pomolobus* and *Erimyzon*. At Cape May they are reported to be preyed on by most ducks, such as the red-breasted and common mergansers, great and little blue herons, green heron, bittern and other birds. They were not found in the fresh waters of Lily Lake at Cape May Point. They are more abundant than the preceding, and at times vast schools are found almost everywhere in meadow streams or pools. They run in with the tide, and if one should happen to pole his way up a small inlet the noise made by the efforts of these schools to swim by on the shallow water in order to escape would be found to be quite startling if not noticed before. In these cases I have never seen them altogether stranded, as they always finally wriggle back into the water. Sometimes a few silversides (*Menidia menidia notata*) were found with them. Only very small minnows were found back on the mainland, though everywhere abundant.

*Fundulus heteroclitus* Abbott, Geol. N. J., 1868, p. 820.—Bean, Bull. U. S. F. Com., VII, 1887, p. 148.—Moore, Bull. U. S. F. Com., VII, 1887, p. 148.—Moore, Bull. U. S. F. Com., XII, 1892, p. 360.

*Fundulus zebra* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 342.

*Hydrargyra flavula* Abbott, Am. Nat., IV, 1870, p. 115.

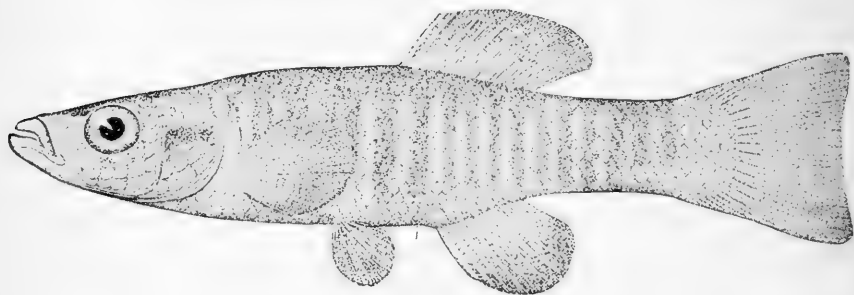
*Fundulus nigrofasciatus* Abbott, Nat. Rambles, 1885, p. 478.

#### **Fundulus diaphanus (Le Sueur).**

Minnow. Killie. Fish. Dog Fish. Blunt Head.  
Barred Minnow.

Head  $3\frac{1}{5}$ ; depth  $4\frac{2}{5}$ ; D. IV, 11; A. II, 11; scales 47 in lateral line to base of caudal and 4 more in latter; 29 scales before dorsal;

14 scales between origins of dorsal and anal; first branched dorsal ray 2 in head; fourth branched anal ray  $1\frac{7}{8}$ ; caudal  $1\frac{1}{3}$ ; pectoral  $1\frac{7}{8}$ ; pectoral  $1\frac{7}{8}$ ; ventral  $2\frac{1}{3}$ ; snout  $3\frac{3}{5}$  in head measured from tip of upper jaw; eye 4; maxillary  $3\frac{2}{5}$ ; interorbital space  $2\frac{7}{8}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ . Body long, rather slender, compressed, and back not elevated. Head flattened or depressed above. Snout rather broad, flattened above. Eye circular, rather large and anterior. Jaws very protractile, lower protruding. Mouth short and wide. Maxillary obliquely vertical, falling well short of orbit or not quite to posterior nostril. Teeth conspicuous, those in outer series enlarged, especially in mandible. Nostril superior on interorbital space in front of eye above. Interorbital space broad and flat. Gill-rakers 6 weak

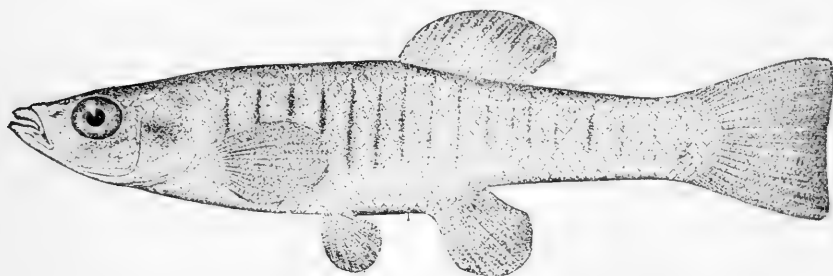


Barred Minnow. *Fundulus diaphanus* (Le Sueur). (Male.)

denticles. Scales small, those on costal region a trifle more narrowly imbricated than others, and those on caudal peduncle large. Scales on top of head very large. Scales on cheek in 3 series. Dorsal inserted midway between posterior margin of preopercle and base of caudal, and first branched rays highest. Anal inserted a trifle behind origin of dorsal and middle branched rays highest, fin rounded. Caudal rounded. Pectoral not quite reaching ventral. Ventral inserted midway between origin of pectoral and that of anal. Color pale olive, sides silvery, and about 20 silvery vertical lines, narrower than dark inter-spaces. Fins plain, dorsal and caudal slightly dusky-olive tinted. Length  $3\frac{3}{8}$  inches. Lily Lake, at Cape May Point.

Color of the above male in life, translucent olivaceous above, margin of each scale diffusely dusky. Top of head tinted with

pale dusky. About 23 transverse narrow brassy or dilute yellowish bands on side, dark spaces between a little broader. On abdominal region below they are more or less whitish, and on body below and posterior to vent dilute azure. Side of head brassy-bluish or with golden tints. Iris beautiful pale brownish with whitish or pearly reflections. Dorsal and caudal brownish, latter immaculate, and former with four or five very distinctly defined dusky longitudinal bands, most distinct on last few rays. Peritoneum showing through abdomen pale whitish. Lower surface of branchial region tinted with pale sulphury. Pectoral tinted with saffron. Ventral and anal pale orange with some blotches of dilute bluish-white basally, those at bases of rays larger and not extending very far down on fin. Jaws brownish. The adult



Barred Minnow. *Fundulus diaphanus* (Le Sueur). (Female.)

female is dilute brownish in life, rather translucent, and with a silvery peritoneum showing through the abdomen. Flanks tinted with pale purplish. Lower surface of head silvery. Cheeks and side of head posteriorly, tinted with dilute purplish. Greenish tints on side of opercle above. Top of head and jaws brownish. Iris dilute purplish or pearly-white. Side of body with about fourteen narrow dusky transverse bands. Dorsal, caudal, pectoral and anal brownish, pectoral and anal paler, and ventral with paler or whitish margin.

Color of male in life similar to adult examples noted above from Cape May point, May 7th, 1905. Posterior margin of caudal blackish, pectoral, anal and ventral more amber tinted. Caudal also slightly tinted with amber in some examples. Anal

with basal blotches. Colors of most all examples were as a rule altogether duller than those from Cape May point. Posteriorly the males appeared more bluish, and the costal region with more or less golden reflections. Iris with dull bluish or brownish reflections. Crosswicks Creek at Trenton, May 9th, 1905. Associated with the large schools of *Fundulus heteroclitus macrolepidotus*.

Very abundant in all small streams, but less so in brackish or salt water with the preceding, in which latter however it is found sometimes. Small pools along the Delaware will generally be found to contain this fish if no other. When seen in clear water they have a transparent appearance, the vertical bands on the side blending with or as shadows, so that the specific name is very appropriate. In some places above tide-water they congregate in immense schools, together with *Notropis analostanus*. Along the salt marshes they are preyed on by *Aythya americana*, *Ardea herodias*, *Botaurus lentiginosus*, *Butorides virescens* and *Nycticorax nycticorax naevius*. It is also probable that *Larus argentatus* will eat them, as they are known to devour large numbers of *Fundulus heteroclitus macrolepidotus* about Cape May at times. Schools of about 50 individuals were found all about the flats of the Great Egg Harbor tide-water. Most examples were small.

*Fundulus diaphanus* Baird, 9th An. Rep Smiths. Inst., 1854, p. 343.—Abbott, Nat. Rambles, 1885, p. 478.—Bean, Bull. U. S. F. Com., VII, 1887, p. 148.

*Hydrargyra swampina* Valenciennes, Hist. Nat. Poiss., XVIII, 1845, p. 152.—Abbott, Geol. N. J., 1868, p. 820.

*Fundulus multifasciatus* Baird, l. c., p. 344.—Abbott, l. c.—Abbott, Am. Nat., IV, 1870, pp. 100, 105.—Abbott, Rep. U. S. F. Com., 1875-76, p. 837.

### Genus ZYGONECTES Agassiz.

#### The Top Minnows.

#### *Zygionectes luciae* (Baird).

#### PLATE 18.

Head less than  $\frac{1}{4}$  of total; D. 8; A. 9; V. 6; P. 15. General form elongated, though of rather short appearance. Anal in-



serted slightly before dorsal and rather more developed. Tail large. Ventral small, reaching vent. Color dark olive-green above, lower part of sides and beneath rich ochre-yellow. Sides with 10 or 12 broad well defined vertical dark bars, nearly as large as inter-spaces which are of faint greenish-white tint. All fins but dorsal uniform yellowish, lighter on abdomen. Dorsal yellow on terminal half, basal portions olivaceous with a large black spot posteriorly, and immediately anterior to it a white one. Dark spot bordered above and behind by yellow part mentioned. One example with posterior half of base of dorsal dull white, with large subcircular spot of black in center. Pectoral similar, dorsal unspotted and yellow less intense. Length 1 inch. In a small ditch at Robinson's Landing, Peck's beach, opposite Beesley's Point. (Baird.)

Known only from the above account by Baird. Dr. Abbott says that it proves to be quite common in the brackish waters of the state generally, a statement which needs verification.

*Hydrargyra lucia* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 344.

*Micristius lucias* Abbott, Geol. N. J., 1868, p. 820.

*Fundulus lucia* Bean, Bull. U. S. F. Com., VII, 1887, p. 147, from Baird.

### Genus LUCANIA Girard.

#### The Rain Water Fishes.

##### **Lucania parva** (Baird).

##### Little Killie Fish.

Head  $3\frac{2}{7}$ ; depth  $3\frac{2}{5}$ ; D. 11, 8; A. iv, 7; scales 28 in lateral line to base of caudal and 2 more on latter; 13 scales before dorsal; 9 scales between origins of dorsal and anal; height of dorsal  $1\frac{1}{2}$  in head; height of anal 2; caudal  $1\frac{1}{8}$ ; least depth of caudal peduncle  $1\frac{7}{8}$ ; snout  $4\frac{1}{4}$  in head measured from tip of upper jaw; eye  $2\frac{4}{5}$ ; maxillary 3; interorbital space  $2\frac{1}{2}$ . Body rather deep, compressed, greatest depth at origin of ventral, back not elevated and lower profile much more convex anteriorly, also much more so than upper. Caudal peduncle deep, compressed.

Head deep, compressed, flattened above. Muzzle blunt. Eye large, circular, anterior. Mouth small, superior, with mandible vertical and projecting. Maxillary vertical, not to nostril. Teeth conic, uniserial and rather small. Upper jaw protractile. Nostril superior anteriorly to eye in interorbital space. Interorbital space broad and flattened. Gill-rakers 5 short weak points. Scales large, forming a lateral line from opposite origin of dorsal to base of caudal, consisting of a single puncture to each scale and traversing 19 scales. At this point 4 scales above and 4 below. Scales on top of head large. Small scales on base of caudal. Scales on cheek in 2 series. Origin of dorsal midway between tip of mandible and base of caudal. Origin of anal a little behind that of dorsal. Caudal large, rounded. Pectoral reaching beyond ventral. Ventral inserted well beyond dorsal and reaching anal. Color olive, pale below, and edges of scales on back slightly darker. Dorsal with a dusky spot anteriorly, ocellated with orange and fin largely dusky-orange. Ventrals and anal orange-red tipped with dusky. Caudal orange-yellow tipped with black. Pectorals pale. Length  $1\frac{5}{16}$  inches. Cape May.

Known to me from 2 examples secured on the Cape May marshes by Mr. H. L. Viereck who reports it as common. Mr. Viereck during his mosquito investigations also reports that the marshes of the greater portion of the southern part of the state have been examined for *Gambusia*, but without success, though many examples of *Lucania*, *Fundulus*, *Cyprinodon* and *Menidia* were taken. The female is pale olive without the bright markings of the male.

*Cyprinodon parvus* Abbott, Geol. N. J., 1868, p. 820, from Baird.

*Lucania parva* Bean, Bull. U. S. F. Com., VII, 1887, p. 148, Pl. 2, fig. 18.

### Genus CYPRINODON Lacépède.

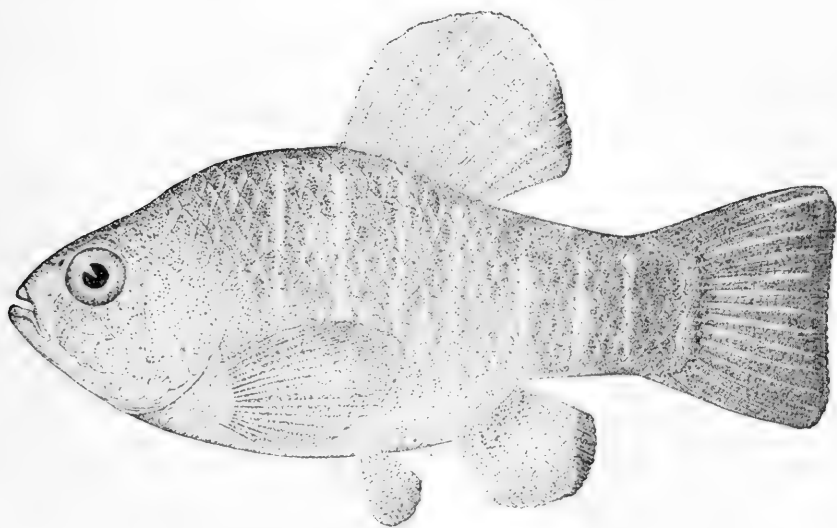
#### The Pursy Minnows.

#### *Cyprinodon variegatus* Lacépède.

#### Killi Fish. Pursy Minnow.

Head  $3\frac{1}{6}$ ; depth  $2\frac{1}{10}$ ; D. 1, 10; A. 1, 9; scales 24 in a lateral series to base of caudal and 3 more on latter; 19 scales before

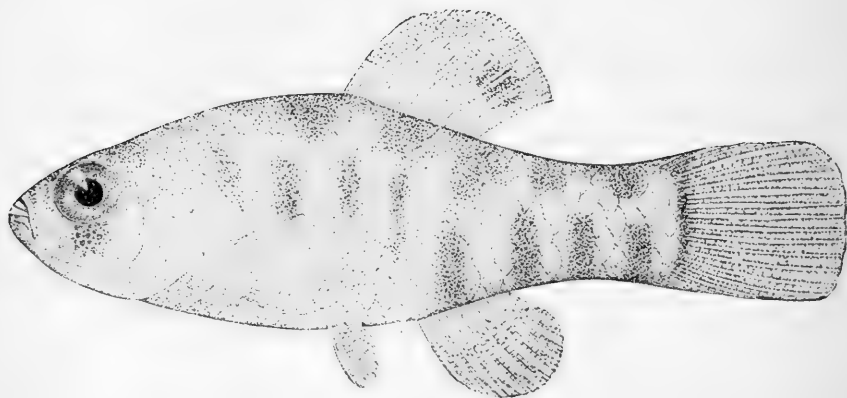
dorsal; 13 scales between origins of dorsal and ventral; third branched dorsal ray nearly equal to head; fifth branched anal ray  $1\frac{7}{8}$ ; caudal  $1\frac{1}{5}$ ; pectoral  $1\frac{1}{5}$ ; ventral  $2\frac{1}{3}$ ; least depth of caudal peduncle  $1\frac{2}{5}$ ; snout 4 in head, measured from tip of upper jaw; eye  $3\frac{1}{8}$ ; maxillary 3; interorbital space  $2\frac{2}{5}$ . Body deeply ovoid, compressed, robust, and back well elevated. Caudal peduncle short, compressed, and its least depth about equal to its length. Head short, little depressed above and narrowed upward and forward. Snout broadly depressed or flattened above. Eye circular, about first  $\frac{2}{5}$  in length of head. Mouth small, horizontal,



Popsy Minnow. *Cyprinodon variegatus* Lacépède. (Adult male.)

and maxillary vertical, not reaching orbit. Jaws wide, lower protruding and upper protractile. Teeth large wedge-shaped incisors, cutting-edge tricuspid, and each tooth expanded towards edge. Nostril above eye anteriorly. Interorbital space broad and flat. Opercle joined by membrane to shoulder-girdle just above origin of pectoral. Gill-rakers about 18 short weak fleshy points. Scales large, becoming smaller posteriorly on body, and especially on belly and base of caudal. Scales very large on top of head and 3 series on cheek. Humeral scale greatly enlarged. Origin of dorsal nearer tip of snout than base of caudal, and

depressed fin reaching  $\frac{2}{3}$  of space to latter. Anal inserted below bases of posterior dorsal rays, and reaching  $\frac{2}{3}$  of space to latter. Caudal truncate, corners angular. Pectoral long, reaching a little beyond origin of ventral. Ventral inserted a little behind origin of dorsal. Color olivaceous-blue, belly and lower surface of head pale pinkish-white. Dorsal blackish, margined in front with orange. Pectorals and ventrals dusky-orange. Caudal grayish with a blackish posterior margin and another narrow line transversely at base. Scales on base of caudal pale. Length  $2\frac{5}{16}$  inches. A male taken in June at Cape May. A female with same data shows—Head 3; depth  $2\frac{1}{3}$ ; D. 1, 11; A. 1, 9; scales 23 in a lateral series to base of caudal and 3 more on



Porsy Minnow. *Cyprinodon variegatus* Lacépède. (Young.)

latter; snout  $3\frac{1}{8}$  in head, measured from tip of upper jaw; eye  $3\frac{1}{5}$ ; interorbital space  $2\frac{1}{4}$ ; fourth dorsal ray  $1\frac{2}{3}$ ; fourth anal ray 2; caudal  $1\frac{1}{2}$ . Origin of dorsal nearly midway between front of orbit and base of caudal. Color light olive, sides with about 15 alternately wide and narrow vertical dark or dusky bars, and about 8 cross bars on back alternating with those below. Belly pale brassy. Dorsal dusky with an obscurely ocellated black blotch near tips of last rays. Caudal gray and a narrow dusky bar at base before scales, which are pale. Other fins dull orange. Length  $2\frac{3}{16}$  inches.

Abundant in the Cape May and Grassy Sound shallows. I have examined many examples, both from these localities, Sea

Isle City, Beesley's Point and Atlantic City. They seem most abundant in the salt ponds. Mr. Viereck reports that the spawning habits of this fish are similar to those as described under *Fundulus heteroclitus macrolepidotus*. It reaches a length of fully 3 inches.

*Cyprinodon variegatus* Abbott, Geol. N. J., 1868, p. 820.—Bean, Bull, U. S. F. Com., VII, 1887, p. 148.—Moore, Bull. U. S. F. Com., XII, 1892, p. 359.

*Cyprinodon ovinus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 345.

## Order ACANTHOPTERI.

### The Spiny Rayed Fishes.

This order includes the vast majority of recent fishes. Many of the so-called sub-orders given below are as yet imperfectly understood and the accompanying key at best is provisional.

#### Key to the sub-orders.

- a. Ventrals abdominal or thoracic.
  - b. Cranium not twisted so that both eyes of the adult are on same side of head.
  - c. Spinous dorsal not modified into a lamellated sucking-disk on top of head.
  - d. Ventral rays graduated from outer which are longest, and inner shortest.
  - e. Ventrals abdominal.
    - f. No spinous fins; lower pharyngeals co-ossified; lateral line on side of abdomen; air-vessel without duct in adult. SYNENTOGNATHI
    - ff. A separate spinous dorsal and other fins with spines; lower pharyngeals not co-ossified; lateral line median or obsolete. PERCESOCES
  - ee. Ventrals sub-abdominal when present.
    - g. Gills normal; body naked or sometimes with bony lateral shields. HEMIBRANCHII
    - gg. Gills tufted; skin covered with bony plates. LOPHOBRANCHII
- eee. Ventrals thoracic when present.
  - h. Suborbital without bony stay back from sub-orbital ring to or toward preopercle.
  - i. Post-temporal slender, divided at tip and not co-ossified with skull.

- j.* A slit behind last gill; lower pharyngeals separate, or very rarely coalescent; scales cycloid or ctenoid. PERCOMORPHI
- jj.* No slit behind last gill; lower pharyngeals fully without suture; scales cycloid. PHARYNGOGNATHI
- ii.* Post-temporal typically co-ossified with skull.
  - k.* Maxillary normal. SQUAMIPENNES
  - kk.* Maxillary co-ossified with premaxillaries and dentaries with articulators.
  - l.* Teeth in jaws distinct.
    - m.* Skin covered with scales of moveable plates; spinous dorsal present. SCLERODERMI
    - mm.* Body covered with immovable bony scutes forming a carapace; spinous dorsal obsolete. OSTRACODERMI
  - ll.* Teeth coalescent into 1 or 2 bony plates in each jaw; no spinous dorsal or ventrals. GYMNOONTES
- hh.* Suborbital with bony stay back from suborbital ring to or toward preopercle.
  - n.* Pectoral fin simple; shoulder-girdle and jaws normal. PAREIOPLITÆ
  - nn.* Pectoral fin divided in 2 parts, or with free detached rays; widely-separated shoulder-girdle peculiarly modified; post-temporal forming integral part of skull; postero-temporal crowded out of place above and on each side of post-temporal. CRANIOMI
- dd.* Inner ventral rays of each fin longest. GOBIOIDEI
- cc.* Spinous dorsal modified into a lamellated sucking-disk on top of head. DISCOCEPHALI
- bb.* Cranium twisted so that both eyes are on same side of head in adult; dorsal and anal very long; no spines in fins. HETEROSOMATA
- aa.* Ventrals jugular.
  - o.* Pseudobranchiæ present; spinous dorsal usually long. JUGULARES
  - oo.* No pseudobranchiæ; spinous dorsal very short. HAPODOCI

## Sub-Order SYNENTOGNATHI.

## The Synentognathous Fishes.

They are allied to the *Haplomi* and the *Percesoces* and similarly indicating transition from the soft-rayed to the spiny-rayed fishes.

*Key to the families.*

- a. Both jaws produced in the adult; upper short in young.
  - b. No finlets. MASTACCEMBELIDÆ
  - bb. Dorsal and anal with detached finlets. SCOMBRESOCIDÆ
- aa. Lower jaw only, if at all, produced.
  - c. Lower jaw produced in the adult. HEMIRAMPHIDÆ
  - cc. Lower jaw not produced. EXOCETIDÆ

## Family MASTACCEMBELIDÆ.

## The Needle Fishes.

Body elongate, very slender, compressed or not. Both jaws produced in a beak, lower jaw longer, very much longer in the young. Maxillaries grown fast to premaxillaries. Each jaw with a band of small sharp teeth, besides a series of longer wide-set sharp conical teeth. Lower pharyngeals united to form a long slender narrow plate with flat surface and covered with small pointed teeth. Upper pharyngeals distinct, third pair little enlarged, and each with some 15 moderate unequal pointed teeth. Fourth pair well developed with similar teeth but without anterior processes. Air-vessel present. Vertebrae numerous with zygopophyses. Ovary single. Body covered with small thin scales. Lateral line very low, running as a fold along side of belly. Dorsal fin opposite anal, both rather long. No finlets.

Carnivorous fishes bearing a superficial resemblance to the gar pikes and also like them very voracious. Found in all warm seas and sometimes entering fresh-water. Their habits are ordinarily much like those of the pike, but when startled they swim along the surface of the water with extraordinary

rapidity, often leaping or skipping out for short distances. When thus leaping the large species of the tropics are sources of danger to incautious fishermen, sometimes piercing the naked abdomens of savages. Most are good food-fishes, though avoided on account of the green color of the bones of the larger species for no good reason. Two species have been recorded from our waters.

### Genus TYLOSURUS Cocco.

#### The Green Gars.

#### *Key to the species.*

- a.* Dorsal rays 15.  
*aa.* Dorsal rays 22 to 25.

MARINUS  
 RAPHIDOMA

#### **Tylosurus marinus** (Walbaum).

Gar. Bill Fish. Sword Fish. Silvery Gar. Green Gar. Snip-pick. Sea Pike. Silver Gar Fish. Harvest Pike. Silver Gar.



Green Gar. *Tylosurus marinus* (Walbaum).

Head  $2\frac{3}{4}$ ; depth  $1\frac{3}{4}$ ; D. II, 12, I; A. II, 16; scales about 250 in lateral series to base of caudal; about 175 scales before dorsal; eye 3 in postocular region; interorbital space  $2\frac{1}{4}$ ; pectoral  $1\frac{1}{10}$ ; ventral  $1\frac{9}{10}$ ; first branched dorsal ray  $1\frac{1}{4}$ ; first branched anal ray  $1\frac{1}{5}$ ; least depth of caudal peduncle  $3\frac{1}{2}$ ; lower caudal lobe 1. Body slender, cylindrical. Caudal peduncle moderately depressed, broader than deep, and flattened below. Head long, flattened above and with broad, shallow median groove. Jaws narrowly tapering to tips, lower longer, and upper from eye  $2\frac{1}{3}$  times rest length of head. Orbit irregularly rounded. Maxillary well exposed, not reaching front margin of pupil. Teeth sharp and mouth not quite closing. Scales thin, small. Lateral line passing into a low keel on side of caudal peduncle.



Dorsal inserted behind last fourth of entire length. Anal inserted well before dorsal and larger. Pectoral reaching about one-third to ventral, which is inserted nearer base of caudal than eye, and extending a little over one-third to anal. Color greenish, scales and bones also same tint, sides silvery. A narrow silvery lateral stripe. A dark bar on opercle. Fins dull olive. Length  $22\frac{1}{2}$  inches. Delaware River.

Abundant on our coast, and in the Delaware as far as Trenton at least, also in the Raritan. I have examples from Beesley's Point, Corson's Inlet, Barnegat, Sea Isle City and Atlantic City. Said to reach a length of 4 feet. A good food-fish, but avoided usually on account of the greenish color of the bones and flesh, especially by the ignorant, who regard it as poisonous. Prof. Ulric Dahlgren has taken the young in the summit-level of the Delaware and Raritan Canal with the yolks-sac still adhering. At Cape May small ones run ashore, though they seldom reach a foot in length, and they are also sometimes taken in seines.

*Tylosurus marinus* Bean, Bull. U. S. F. Com., VII, 1887, p. 146.—Moore, Bull. U. S. F. Com., XII, 1892, p. 360.—Smith, Bull. U. S. F. Com., XII, 1892, p. 369.—E. Smith, Trans. Linn. Soc. N. Y., IX, 1897, p. 38.

*Belone truncata* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 346.

*Belone longirostris* Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 95.—Abbott, Geol. N. J., 1868, p. 815.—Abbott, Am. Nat., IV, 1870, p. 105.

*Belone acutirostris* Abbott, Nat. Rambles, 1885, p. 478.

#### ***Tylosurus raphidoma* (Ranzani).**

PLATE 19.

Gar.

Head  $3\frac{1}{10}$ ; depth  $15\frac{1}{2}$ ; D. II, 20; A. III, 19; pectoral  $3\frac{7}{8}$  in head; ventral  $4\frac{7}{8}$ ; least depth of caudal peduncle 12; lower lobe of caudal 3; snout  $1\frac{2}{3}$  in head, measured from tip of upper jaw; eye 7; gape of mouth  $1\frac{9}{10}$ . Jaws rather short, stiff, rapidly tapering in front, and lower protruding. Eye a little longer than deep, 2 in postocular region. A dark cutaneous flap attached

along side of mandible and folded underneath, meeting its fellow on opposite side and concealing a small portion of lower jaw. Dorsal inserted a trifle behind last fourth in space between tip of mandible and base of caudal, margin concave at first and becoming convex behind where longest ray equals distance from middle of eye to end of head. Caudal slightly emarginate, upper lobe  $1\frac{1}{2}$  in lower. Anal inserted a little behind origin of dorsal, first rays highest. Pectoral a little less than one-third to ventral. Ventral about midway between front of eye and base of caudal. Color greenish on back. Under surface, except mandibular flap, silvery. On sides 14 black blotches not extending to caudal, and largest two-thirds as wide as length of eye. Dorsal black, except on first six rays, which are pale. Paired fins and anal pale. Caudal small, except anterior half of upper lobe, on which membrane covering rays is black, intervals between rays pale. Length  $6\frac{1}{2}$  inches. Ocean City. (From Bean.)

A straggler in the Gulf Stream from tropical America, has only been noted on one occasion by Dr. Bean. It differs from our common gar chiefly in the increased dorsal and anal radii. It is said to attain even a larger size, 5 feet.

*Tylosurus gladius* Bean, Bull. U. S. F. Com., VII, 1887, p. 146, Pl. 2, fig. 15.

### Family SCOMBRESOCIDÆ.

#### The Sauries.

Body elongate, compressed, general aspect that of a mackerel. Both jaws in adult more or less prolonged, forming a slender beak, and upper always longer. Teeth very feeble, pointed. Maxillaries joined fast to premaxillaries. Gill-rakers numerous, long and slender. Pharyngeal bones essentially as in *Exocoetus*. Fourth upper pharyngeal on each side wanting or fused with third. Third pharyngeal greatly enlarged, separate from its fellow, covered with tricuspid teeth. Second with simple teeth. First toothless. Lower pharyngeals united, forming a triangular bone with concave surface, covered with tricuspid teeth. Into hollow of this bone upper pharyngeals fit. Body covered with

thin deciduous scales. Dorsal and anal low, similar to each other, each with 4 to 9 detached finlets as in *Scombridæ*. Pectorals and ventrals small.

Pelagic fishes swimming close to the surface in large schools in temperate regions. They bear a close resemblance to the mackerels in form, color and habits, as well as in the dorsal and anal finlets, the significance of which resemblance is unknown. One species recorded from our shore.

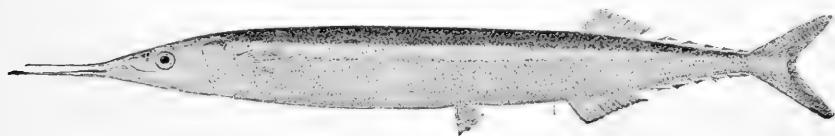
### Genus *SCOMBRESOX* Lacépède.

#### The Sauries.

*Scombresox saurus* (Walbaum).

#### Bill Fish.

The single species on our coast may easily be determined from any of its relatives by the presence of dorsal and anal finlets.



Bill Fish. *Scombresox saurus* (Walbaum).

It is said to reach a length of 18 inches. As they assemble in large schools they are preyed on by tunnies or other predatory fishes. I have no New Jersey examples, but include the species on Dr. Abbott's reference.

*Scomberesox scutellatus* Abbott, Geol. N. J., 1868, p. 814.

### Family *HEMIRAMPHIDÆ*.

#### The Balaos.

Body elongate, more or less compressed. Upper jaw short, lower various, sometimes much produced, and toothed portion at base fitting against toothed premaxillaries. Teeth equal, mostly small and tricuspid. Maxillaries ankylosed to premaxillaries.

Gill-rakers long. Third upper pharyngeal on each side much enlarged, solidly united with its fellow to form an oval plate with slightly convex surface and covered with blunt tricuspid teeth. This about as large as united lower pharyngeals and fits into concavity of latter. Fourth upper pharyngeal wanting or grown fast to third. Lower pharyngeal large, thick, triangular and with concave surface. Air-vessel large, sometimes cellular. Vertebrae about 50. No finlets. Anal fin modified in viviparous species, unmodified in others, and usually similar to dorsal. Caudal fin rounded or forked, if forked lower lobe longer.

Herbivorous fishes of warm seas, mostly along shore, though a few pelagic. Their food is mostly green algæ, and like related forms swim at the surface, occasionally leaping into the air. Size rather small, usually about a foot in length.

### *Key to the genera.*

- a. Body moderately compressed; pectorals moderate; shore fishes. HYPORHAMPHUS  
 aa. Body very slender and compressed, more or less band-like; pectorals very long; pelagic fishes. EULEPTORHAMPHUS

### Genus *HYPORHAMPHUS* Gill.

#### The Half Beaks.

#### *Hyporhamphus unifasciatus* (Ranzani).



Half Beak. *Hyporhamphus unifasciatus* (Ranzani).

Head  $2\frac{2}{3}$ ; depth 8; D. II, 13; A. III, 13; scales 53 in lateral series to base of caudal and 3 more on latter; 8 scales between origins of dorsal and anal; snout  $2\frac{3}{4}$  in head measured from tip of upper jaw; eye 4; gape of mouth  $4\frac{1}{2}$ ; interorbital space 4; pectoral  $1\frac{2}{3}$ ; base of dorsal  $1\frac{1}{2}$ ; base of anal  $1\frac{2}{5}$ ; ventral  $2\frac{2}{3}$ ; least depth of caudal peduncle 4. Body elongate, moderately com-

pressed, and profiles similar. Snout triangular, a trifle broader than long. Eye a little elongate, and pupil elongate. Teeth weak. Mandible to tip of upper jaw a little longer than rest of head. Interorbital space flat. Gill-rakers about  $9 + 20$ , long, slender. Scales large. Dorsal inserted at last fourth in trunk. Anal similar and but a trifle posterior. Pectoral  $\frac{2}{3}$  to ventral, which is inserted before dorsal a space equal to a little over base of same. Ventral reaching a trifle over  $\frac{1}{3}$  to anal. Color translucent greenish above. A silvery band becoming as wide as length of pupil between dorsal and anal. Iris silvery. Lower surface of body pale. Length  $6\frac{1}{2}$  inches. New Jersey.

I have 2 examples without definite locality. The young have a longer beak. Reaches a foot in length.

*Hemirhamphus roberti* Bean, Bull. U. S. F. Com., VII, 1887, p. 147, Pl. 3, fig. 16.

#### Genus EULEPTORHAMPHUS Gill.

##### The Ribbon Half Beaks.

##### *Euleptorhamphus velox* (Poey).

Head, from tip of upper jaw, 7; depth 12; D. 11, 20; A. 11, 20; snout 3 in rest of head; eye  $3\frac{1}{2}$ ; maxillary  $2\frac{7}{8}$ ; interorbital space  $3\frac{3}{4}$ ; ventral  $3\frac{2}{3}$ ; least depth of caudal peduncle  $4\frac{1}{2}$ . Body slender, almost band-like, much compressed and greatly elongated. Head compressed, sloping below so that its lower edge is very narrow, almost a keel, and upper surface flattened. Snout short, forming an equilateral triangle as viewed from above. Eye large, nearly circular. Mandible prolonged greatly into a slender point, and measured to tip of upper jaw, more than twice length of head. Teeth minute, in narrow bands in jaws. Interorbital space flat. Gill-rakers short and rather numerous. Scales deciduous, rather large. Lateral line low. Dorsal beginning a little behind last third in space between tip of snout and base of caudal, and anterior rays elevated. Anal similar, beginning a little behind dorsal. Caudal with lower lobe much longer than upper. Pectoral long, falcate, and reaching a little more than half way to

ventral. Ventral very small, falling a little nearer base of caudal than origin of pectoral. Color pale brownish, more or less brightly silvered, especially eyes and sides. Length about  $15\frac{1}{2}$  inches. Atlantic City.

This account is from the only example I have seen, which was taken some years ago and recorded by Cope.

*Hemirhamphus macrorhynchus* Cope, Proc. Acad. Nat. Sci. Phila., 1870, p. 121.

### Family EXOCETIDÆ.

#### The Flying Fishes.

Body oblong or elongate. Head with vertical sides. Mouth moderate, terminal. Jaws not prolonged into a beak. Premaxillaries not protractile, hinged at base mesially. Margin of upper jaw chiefly formed by premaxillaries. Short maxillaries entering lateral margin. Maxillary free from premaxillary, its edge slipping under front of preorbital. Dentition various, teeth small and weak. Nostrils large, double, near eye. Gill-membranes not united, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers various. Pseudobranchiæ hidden, glandular. Lower pharyngeals enlarged and fully united, forming a large transversely concave plate covered with large close-set blunt tricuspid teeth. Third upper pharyngeal greatly enlarged, not united with its fellow, and both covered with large blunt tricuspid teeth. Fourth superior pharyngeal wanting in adult. Vertebrae without zygopophyses, about 50. Air-vessel very large, not cellular so far as known, and extending far backward among hæmopophyses of caudal vertebrae. Intestinal canal simple, without cæca. Shoulder-girdle and pectoral muscles very strong. Body covered with deciduous cycloid scales. Lateral line running very low along sides of belly. Head more or less scaly. Dorsal fin without spines, inserted on posterior part of body opposite anal and more or less similar. No finlets. Pectoral fins inserted high and used as organs of flight. Ventrals abdominal, of several soft rays, inserted posteriorly. Vent close in front of anal.

Carnivorous or herbivorous fishes abounding in all warm seas, mostly pelagic, swimming near the surface, and skipping or sail-

ing through the air sometimes for considerable distances. Two species have been noted from our shores.

Genus *CYPSSELURUS* Swainson.

The Flying Fishes.

*Key to the species.*

- a.* Dorsal and anal fins without black markings; ventrals pale. *HETERURUS*  
*aa.* Dorsal and anal marked with black, former with one or more dark blotches, and anal with a black spot on tips of third to sixth rays; ventrals black with pale edging and a white spot near base. *FURCATUS*

*Cypselurus heterurus* (Rafinesque).

Flying Fish. Single Bearded Flying Fish.

I have no examples of this species. The one mentioned by Dr. Abbott from Beesley's Point cannot now be found in the Museum of the Academy of Natural Sciences of Philadelphia.



Flying Fish. *Cypselurus heterurus* (Rafinesque).

*Exocetus heterurus* Smith, Bull. U. S. F. Com., XII, 1892, p. 370.

*Exocetus noveboracensis* Abbott, Geol. N. J., 1868, p. 815.

*Cypselurus comatus* Abbott, l. c.

*Cypselurus furcatus* (Mitchill).

Double Bearded Flying Fish.

Distinguished from the preceding chiefly by the larger scales which are about 46 in the lateral line and about 29 in front of dorsal.

It is only known from Dr. Abbott's reference.

*Cypselurus fercatus* Abbott, Geol. N. J., 1868, p. 815.

### Sub-Order PERCESOCES.

#### The Perch Pike Fishes.

#### Key to the families.

- a. Lateral line wanting; teeth small or wanting.
  - b. Carnivorous; body and head elongate; stomach not gizzard-like. ATHERINIDÆ.
  - bb. Eating mud and vegetation; head short and broad; stomach gizzard-like with long intestines. MUGILIDÆ.
- aa. Lateral line present; teeth strong, unequal; head long and pointed. SPHYRÆNIDÆ.

### Family ATHERINIDÆ.

#### The Silversides.

Body rather elongate, somewhat compressed. Cleft of mouth moderate. Teeth small, on jaws and sometimes on vomer and palatines, rarely wanting. Premaxillaries protractile or not. Opercular bones without spines or serrature. Gill-openings wide. Gill-membranes not connected, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers usually long and slender. Pseudo-branchiæ present. Branchiostegals 5 or 6. Third and fourth superior pharyngeals co-ossified, with teeth. Air-vessel present. No pyloric cæca. Vertebrae numerous, usually about  $23+23=46$ . Body covered with scales of moderate or small size, which are usually, but not always, cycloid. No lateral line, some scales often with rudimentary mucous tubes. Dorsal fins 2, well separated, first of III to VIII slender flexible spines, second of soft rays. Anal with a weak spine, similar to soft dorsal, but usually larger. Pectorals moderate, inserted high. Ventrals small, abdominal, not far back, of I small spine and 5 soft rays.

Carnivorous fishes, mostly small, living in great schools near the shore of temperate and tropical seas, a few in fresh-water. All have a silvery band along the sides, sometimes underlaid by



black pigment. All which are large enough are highly valued as food.

*Key to the genera.*

- a. Scales with ragged or jagged edges.  
 aa. Scales entire.

KIRTLANDIA  
 MENIDIA

Genus KIRTLANDIA Jordan and Evermann.

The Rough Scaled Silversides.

*Kirtlandia vagrans laciniata* (Jordan and Gilbert).

White Bait. Silver Fish. Silversides.

Head 5; depth  $5\frac{3}{5}$ ; D. V-II, 7, 1; A. II, 20, 1; scales about 50 in lateral line to base of caudal; 8 scales between origin of spinous dorsal and that of anal; 30 scales before spinous dorsal; snout  $3\frac{1}{3}$  in head; eye  $3\frac{1}{3}$ ; interorbital space 3; pectoral 1; ventral  $2\frac{1}{8}$ ; spinous dorsal  $3\frac{7}{8}$ ; first branched dorsal ray  $2\frac{1}{8}$ ; first branched anal ray 2; least depth of caudal peduncle  $2\frac{2}{3}$ ; lower caudal lobe 1. Body elongate, compressed. Head small, well compressed, and lower profile more steep than upper. Snout broadly depressed, rounded when viewed above. Eye circular, a little anterior. Upper jaw protruding slightly. Profile of mandible a little concave. Teeth in narrow villiform bands in jaws. Maxillary about  $\frac{2}{3}$  of snout to orbit. Interorbital space broad and only very slightly convex. Gill-rakers  $6 + 17$ , slender, shorter than filaments and about one-half of orbit. Edges of scales strongly crenate or gashed. Lateral line median, more or less even, of short tubes, and beginning on middle of side near end of depressed pectoral. Spinous dorsal inserted nearly midway between origin of pectoral and base of caudal. Rayed dorsal inserted nearer base of caudal than tip of depressed pectoral or about over last  $\frac{2}{3}$  of base of anal. Caudal forked, lobes broad and sharp. Pectoral extending tip opposite origin of ventral, though latter is inserted a little nearer origin of pectoral than that of spinous dorsal, and fin reaching half way to anal.

Soft dorsal and anal scaly. Color translucent pale sandy-brown, each scale of back peppered with dusky, many dots on each scale. Snout and mandible dusky. A broad bright silvery band  $\frac{2}{3}$  width of orbit on side covering third row of scales and bounded above by a narrow leaden line in preserved examples, though not dusted with dark points. Caudal and dorsal dusky, other fins paler. Iris and side of head silvery. Length  $4\frac{1}{4}$  inches. Ocean City.

Color in life of the above translucent pale sandy-brown generally, and the pattern very similar to *Menidia menidia notata*. Each scale on back with small dusky points or dots, much darker than those of *Menidia menidia notata*. A rather broad lateral silvery band, much wider than pupil and but little less than width of orbit, extending from axil of pectoral to base of caudal. Upper margin of silvery lateral band bordered narrowly with slaty-green so that line of demarcation is sharp. Lateral band also of about more or less even width entire length of its course. Top of head and snout brownish with greenish reflections, and dotted a little like scales on back. Lower jaw also sprinkled with a few pale dots. Head and iris otherwise burnished with bright silver. Inside of gill-opening punctuated with brownish and dusky. Peritoneum showing through bright silvery. Fins all more or less dull or pale transparent brown, lower ones scarcely paler.

This beautiful little fish was found fairly abundant on the bar at Ocean City in company with *Menidia menidia notata*, *Trachinotus carolinus*, *Anchovia mitchilli* and *Menticirrhus saxatilis*. It was taken mostly however with *Menidia menidia notata* which it greatly resembles, there being little difference in the colors of the living animals. *Menidia menidia notata* however may easily be distinguished by the paler back, not so peppery in appearance, and the much narrower lateral silvery streak. *Kirtlandia* also appeared to fall a little small in size as compared with *Menidia*, as most all of my examples taken were much smaller. The *Trachinotus* is the longest too die of any of the above mentioned fishes when taken from the water.

*Menidia laciniata* Bean, Bull. U. S. F. Com., VII, 1887, p. 146.

## Genus MENIDIA Bonaparte.

## The Silversides.

*Key to the species.*

a. Anal radii 15 to 17, rarely 19; scales about 38 to 41.

BERYLLINA CEREÆ

aa. Anal radii 20 to 27; scales 39 to 50.

MENIDIA NOTATA

**Menidia beryllina cerea** Kendall.

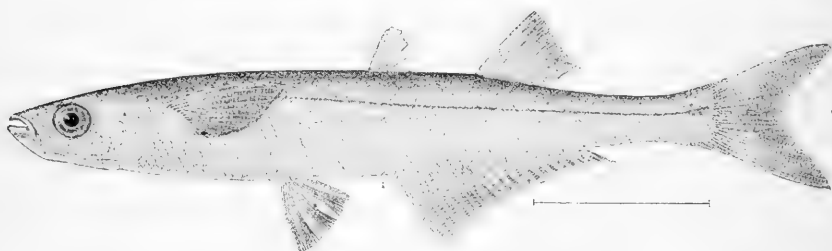
Head 4; depth  $5\frac{1}{2}$ ; D. V-II, 7, 1; A. II, 13; scales 36 in lateral series to base of caudal with about 2 more on latter; 9 scales obliquely between origins of spinous dorsal and anal; 17 scales before dorsal; snout  $3\frac{3}{4}$  in head; eye  $2\frac{3}{4}$ ; interorbital space 3; pectoral  $1\frac{1}{4}$ ; ventral  $1\frac{1}{8}$ ; lower caudal lobe 1; base of anal  $1\frac{1}{10}$ ; least depth of caudal peduncle  $2\frac{7}{8}$ . Body elongate, compressed, and rather fusiform. Head moderate, well compressed, and lower profile much more steep than upper. Snout broadly depressed, rounded when viewed above. Eye large, circular. Mandible protruding a little. Profile of mandible slightly convex. Teeth in narrow villiform bands in jaws. Maxillary not reaching eye. Interorbital space flattened and a little broad. Gillrakers slender, rather long and numerous. Scales entire. Lateral line a series of small pores, one on each scale below lateral stripe. Spinous dorsal inserted midway between tip of snout and base of caudal. Rayed dorsal inserted about over first third of base of anal, nearer base of caudal than origin of pectoral. Caudal forked. Tip of pectoral extending beyond origin of ventral, which is inserted nearer origin of spinous dorsal than that of pectoral. Color translucent sandy-gray. A narrow silvery lateral streak less in width than pupil of eye. Edges of scales on back dusted brown. Fins pale, dorsal and caudal scarcely darker. Length  $1\frac{3}{4}$  inches. Anglesea.

Known to me from our coast by the single example described above which was taken by Messrs W. J. Fox and P. Laurent, October 3d, 1897.

**Menidia menidia notata** (Mitchill).

Silverside. Silversides. Sand Smelt.

Head  $4\frac{1}{2}$ ; depth  $6\frac{1}{4}$ ; D. IV-I, 1, 9; A. I, 1, 22, 1; scales 46 in lateral series from gill-opening above to base of caudal and 4 more on latter; 10 scales between origin of spinous dorsal and that of anal; 28 scales before spinous dorsal; snout  $3\frac{1}{6}$  in head; eye  $3\frac{1}{2}$ ; maxillary  $3\frac{4}{5}$ ; mandible  $2\frac{7}{8}$ ; interorbital space  $3\frac{3}{4}$ ; second dorsal spine  $2\frac{3}{4}$ ; first branched dorsal ray  $1\frac{9}{10}$ ; first branched anal ray  $1\frac{9}{10}$ ; upper caudal lobe nearly 1; least depth of caudal peduncle  $2\frac{3}{4}$ ; pectoral  $1\frac{1}{4}$ ; ventral 2. Body long, slender, compressed. Caudal peduncle compressed. Head compressed, mandible forming oblique profile. Snout flattened above, a trifle broader than long. Eye large, rounded, a little

Silverside. *Menidia menidia notata* (Mitchill).

longer than deep. Mouth horizontal, wide, and jaws equal. Teeth rather large, conic, those in upper inner series a little enlarged. Maxillary nearly vertical, about  $\frac{2}{3}$  of space to orbit. Nostrils superior, well separated, posterior close in front of eye above. Interorbital space broad and flattened. Gill-rakers 6 + 15, slender, lanceolate, and longest about equal to diameter of pupil. Scales large, cycloid, more or less of uniform size or becoming reduced and crowded on base of caudal. Lateral line of simple tubes, rather obscure. Spinous dorsal inserted nearer base of caudal than tip of snout, first 2 spines longest, and fin reaching a trifle over half of space to rayed dorsal. Rayed dorsal inserted nearer tip of pectoral than base of caudal, and

anteriorly elevated. Anal inserted before tip of depressed spinous dorsal or nearer origin of pectoral than base of caudal, and anteriorly elevated. Caudal forked, lobes not especially sharpened. Pectoral broad, reaching ventral. Ventral inserted nearer origin of spinous dorsal than that of pectoral, and reaching half way to anal. Color translucent sandy, scales on back edged with dull dusky or grayish. A silvery lateral band half width of orbit. Chin specked with dusky gray. Fins pale. Length  $4\frac{3}{4}$  inches. Ocean City.

Color of the above in life translucent sandy-brown, edge of each scale on back margined darker with dusky dots. A narrow lateral silvery streak from axilla to base of caudal, sharply defined from back by a narrow streak of hyaline greenish on its upper edge along entire course. Fins translucent like body-color, and without markings. Along base of anal a series of dark hyaline brownish-green dots showing through scales of body. Base of pectoral at shoulder-girdle tinted with dull amber. Top of head and side bright silvery-white and with emerald reflections. Muzzle translucent brownish. Iris bright silvery. Peritoneum showing through bright silvery-white over whole of cœlome. Inside of gill-opening tinted with emerald and dusky.

Very abundant on the New Jersey coast. I have taken very many examples from Atlantic City, Anglesea and Stone Harbor. Prof. Baird's examples from Beesley's Point, and others, are in the Academy's collections. They are abundant in Cape May, and are also found in Delaware Bay. Now used as food or bait.

*Atherinopsis notatus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 338.

*Argyrea notata* Abbott, Geol. N. J., 1868, p. 816.

*Menidia notata* Bean, Bull. U. S. F. Com., VII, 1887, p. 146.  
—Moore, Bull. U. S. F. Com., XII, 1892, p. 360.

### Family MUGILIDÆ.

#### The Mulletts.

Body oblong, more or less compressed. Mouth small. Jaws with small teeth or none, and when present of various form.

Premaxillaries protractile. Gill-openings wide, membranes separate and free from isthmus. Gills 4, slit behind fourth. Gill-rakers long and slender. Pseudobranchiæ large. Branchiostegals 5 or 6. Air-vessel large, simple. Intestinal canal long. Peritoneum usually black. Vertebrae 24. Body covered with rather large cycloid scales. No lateral line but furrows often deepened on middle of each scale so as to form lateral streaks. Two short dorsal fins, well separated, anterior with IV stiff spines the last of which is much shorter than others. Second dorsal longer than first, similar to anal. Anal spines II or III, graduated. Ventrals abdominal, not far back and composed of I spine and 5 rays.

Valuable food-fishes of moderate or small size in the freshwaters and on the coasts of warm regions, feeding on organic matter contained in mud. Two species on our coast.

### Genus MUGIL Linnæus.

#### The Mullet.

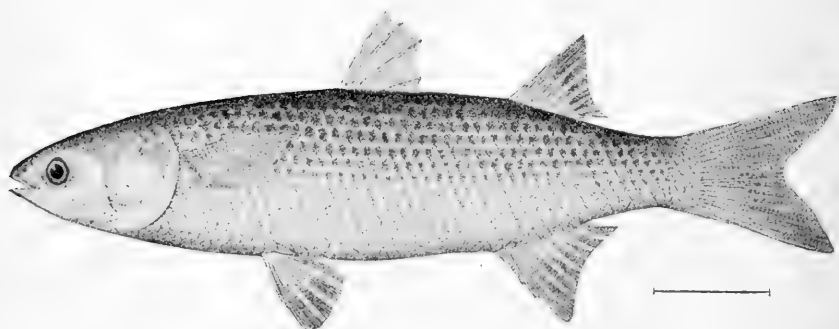
#### *Key to the species.*

- a.* Soft dorsal and anal almost naked.  
*aa.* Soft dorsal and anal covered with minute scales.

CEPHALUS  
CUREMA

#### **Mugil cephalus** Linnæus.

Mullet. Striped Mullet.



Striped Mullet. *Mugil cephalus* Linnæus.

Distinguished from the following species by the naked, or almost naked, soft dorsal and anal fins.

They are apparently not as abundant at Cape May as formerly. They run in at night and disappear in the day. Last fall several big ones were taken in the surf. I have no New Jersey examples. The references to *Mugil petrosus* and *Mugil plumievi* by Dr. Abbott are entirely provisional, as such species are not yet known from our coast.

*Mugil cephalus* Moore, Bull. U. S. F. Com., XII, 1892, p. 360.

*Mugil lineatus* Abbott, Geol. N. J., 1868, p. 816.

*Mugil albula* Bean, Bull. U. S. F. Com., VII, 1887, p. 145.

**Mugil curema Valenciennes.**

Mullet. White Mullet.

Head  $3\frac{2}{3}$ ; depth  $3\frac{1}{2}$ ; D. IV-I, 8; A. III, 9; scales 38 to base of caudal, and 12 between origins of second dorsal and spinous anal; snout  $4\frac{1}{3}$  in head; eye  $3\frac{3}{5}$ ; width of mouth  $3\frac{1}{4}$ ; inter-orbital space  $2\frac{3}{7}$ ; second dorsal spine  $1\frac{4}{5}$ ; first dorsal ray  $1\frac{4}{5}$ ; third anal spine  $2\frac{2}{3}$ ; first anal ray  $1\frac{3}{4}$ ; lower caudal lobe 1; least depth of caudal peduncle  $2\frac{1}{3}$ ; pectoral  $1\frac{3}{7}$ ; ventral  $1\frac{2}{3}$ . Body elongate, compressed, and lower profile more convex than upper. Head large. Snout short, comparatively narrow and obtuse. Eye rounded, near first third of head, and mostly hidden by broad adipose eyelids. Jaws about equal, and rami of mandible would form an equilateral triangle. Teeth minute. Inter-orbital space broad and convex. Gill-rakers about  $15 + 40$ , slender, and a little shorter than filaments, which equal orbit. Soft dorsal, anal and base of caudal densely scaled. About 23 scales before dorsal. Scales on side of head large. Spinous dorsal inserted midway between tip of snout and base of caudal, second spine longest and close to first. Rayed dorsal inserted a little nearer origin of spinous fin than base of caudal, highest in front and margin concave. Anal inserted before soft dorsal, spines graduated to third which is longest, and fin otherwise similar to soft dorsal. Caudal large, broadly emarginate, and tips of each lobe pointed. Pectoral small, broad, inserted level with orbit and reaching about  $\frac{5}{6}$  of space to spinous dorsal.

Ventral inserted a little nearer origin of spinous dorsal than that of pectoral, and reaching a little over half way to anal. Color olivaceous above. Sides silvery. Dorsals and caudal grayish. Base of pectoral slaty-black. Length  $4\frac{1}{8}$  inches. Cape May.

Color of the above when fresh, with back and upper surface of head beautiful deep gray slightly tinged with olivaceous. Side and lower surface pure silver-white, color of back quickly merging into former above where it is pale gray. In certain lights body shows beautiful purplish and ochraceous reflections. On back also 3 distinct longitudinal dark streaks, 1 along each course or series of scales. Iris white, tinted with dull ochraceous. Upper posterior margin of opercle brassy. Dorsals, caudal and pectoral grayish. Base of pectoral slaty. Other fins white.

Small ones are frequently washed on the beach after storms.



White Mullet. *Mugil curema* Valenciennes.

I have examples from Beach Haven, Beesley's Point and Stone Harbor. In life some examples have the back greenish tinted.

*Mugil curema* Bean, Bull. U. S. F. Com., VII, 1887, p. 145.—Moore, Bull. U. S. F. Com., XII, 1892, p. 360.—Fowler, Proc. Acad. Nat. Sci. Phila., 1903, p. 744.

*Mugil albula* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 339.—Abbott, Geol. N. J., 1868, p. 815.

### Family SPHYRÆNIDÆ.

#### The Barracudas.

Body elongate, subterete. Head long, pointed, pike-like. Jaws elongate, lower considerably projecting. Upper jaw nonpro-



tractile, its border formed by premaxillaries behind which are broad maxillaries. Large sharp teeth of unequal size on both jaws and palatines. No teeth on vomer, usually a very strong sharp canine near tip of lower jaw. Opercular bones without spines or serratures. Gill-openings wide, gill-membranes not united, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers very short or obsolete. Pseudobranchiæ well developed. Branchiostegals 7. First superior pharyngeal not present, second, third and fourth separate, with teeth. Lower pharyngeals separate. Air-vessel large, bifurcate anteriorly. Many pyloric cœca. Vertebrae 24. Body covered with small cycloid scales. Head scaly above and on sides. Lateral line well developed, straight. First dorsal, over ventrals, of V rather stout spines. Second dorsal remote from first dorsal, similar to anal and opposite to it. Caudal forked. Pectorals short, placed in or below line of axis of body. Ventrals I, 5, abdominal, in advance of middle of body.

Large carnivorous pike-like fishes, active, voracious, in warm seas, and many highly valued as food. Two species occasionally on our shores.

### Genus SPHYRÆNA Bloch and Schneider.

#### The Barracudas.

#### *Key to the species.*

a. Scales large, about 84 in lateral line.

BARRACUDA

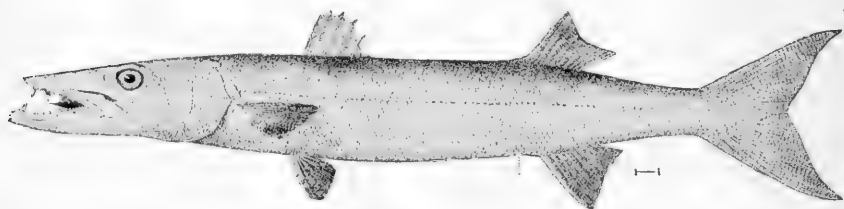
aa. Scales small, 115 to 130.

BOREALIS

#### *Sphyræna barracuda* (Walbaum).

Head  $2\frac{2}{3}$ ; depth  $7\frac{1}{5}$ ; D. V—II, 7; A. II, 7; scales about 84 in lateral line to base of caudal, 5 more on latter; 6 scales obliquely back from origin of dorsal to lateral line; 12 scales obliquely up from root of ventral to lateral line; third dorsal spine  $3\frac{1}{3}$  in head; first dorsal ray  $4\frac{1}{5}$ ; first anal ray  $1\frac{1}{4}$ ; lower caudal lobe about 2; pectoral  $3\frac{2}{3}$ ; ventral 4; least depth of caudal peduncle  $6\frac{3}{4}$ . Body rather robust, greatest depth at origin of ventral. Head large. Snout long, tapering from rather deep base. Eye circular, its front margin about center in length of head. Maxil-

lary large, reaching front of orbit and its expansion about  $\frac{4}{7}$  of latter. Mandible projecting with evident horny tip. Teeth



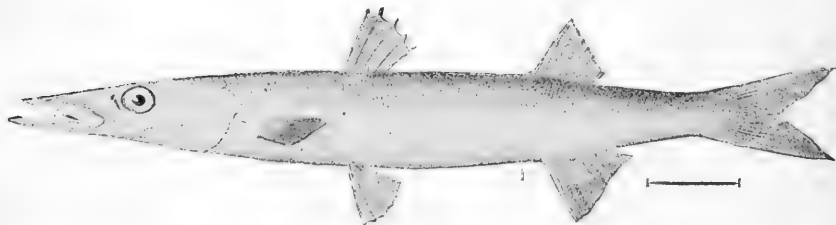
Barracuda. *Sphyræna barracuda* (Walbaum).

large. Lateral line sloping down to middle of depth of body about midway in interdorsal region. Spinous dorsal inserted a little nearer base of caudal than tip of mandible. Rayed dorsal inserted about midway between origin of spinous dorsal and base of caudal. Anal inserted opposite origin of rayed dorsal, and similar. Caudal deeply emarginate with broad lobes. Pectoral evidently reaching beyond spinous dorsal. Ventral inserted before origin of spinous dorsal or about last third of pectoral. A broad diffuse dark lateral band from tip of snout to base of caudal, and broadest on costal region just behind head. Length 2 inches. Beesley's Point. (From Bean.)

Known from our shores by the single young example described above from Dr. Bean's figure. It is very likely a stray from tropical America in the Gulf Stream. The species reaches a length of 6 feet, and is one of the largest and most voracious of the barracudas.

***Sphyræna borealis* De Kay.**

Barracuda. Northern Barracuda.



Northern Barracuda. *Sphyræna borealis* De Kay.

Known from the preceding chiefly by the smaller scales, which are 115 or more in the lateral line.

I have no examples of this species. It is small, rarely more than a foot in length.

*Sphyræna borealis* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 326.—Abbott, Geol. N. J., 1868, p. 812.—Bean, Bull. U. S. F. Com., VII, 1887, p. 145.—Bean, Bull. Am. Mus. N. H., IX, 1897, p. 358.

### Sub-Order HEMIBRANCHII.

The Half Gilled Fishes.

*Key to the families.*

- a. Ventrals each with a sharp spine, each with 1 soft ray, and subthoracic; dorsal spines. GASTEROSTEIDÆ
- aa. Ventrals without spines, each with 6 soft rays, and sub-abdominal; dorsal spines undeveloped. FISTULARIIDÆ

### Family GASTEROSTEIDÆ.

The Sticklebacks.

Body more or less fusiform, somewhat compressed, tapering behind to a slender caudal peduncle. Head moderate, anterior part not greatly produced. Mouth moderate, cleft oblique, lower jaw prominent. Maxillary bent at right angles, and overlapping premaxillary at corner of mouth. Teeth sharp, even, in a narrow band in each jaw. No teeth on vomer or palatines. Premaxillaries protractile. Preorbital rather broad. Suborbital plate large, often covering anterior part of cheeks, forming a connection with preopercle. Opercles unarmed. Gill-membranes broadly joined, free from isthmus or not. Gill-rakers moderate or rather long. Branchiostegals 3. Air-vessel simple. A few pyloric cœca. Vertebrae 30 to 35, anterior little enlarged. Skin naked or with vertically oblong bony plates, no true scales. Middle of sides of belly shielded by pubic bones. Pectoral preceded by a quadrate naked area, which is covered with shining skin. Dorsal fin preceded by 11 or more free spines. Anal similar to soft

dorsal, with a single spine. Pectorals rather short, unusually far behind gill-openings. Caudal narrow, usually emarginate. Ventral fins sub-abdominal, consisting of a stout spine and 1 or 2 rudimentary rays.

Small fishes of the fresh waters and the arms of the seas in northern regions. Noted for their pugnacity, exceedingly destructive to the spawn and fry of larger fishes. Most build elaborate nests, which the male defends with spirit. They are extremely variable and are apparently readily affected by changes in their surroundings.

### *Key to the genera.*

- a. GASTEROSTEINÆ. Pubic bones fully joined, forming a triangular or lanceolate plate on median line of belly behind and between ventrals.
- b. Gill-openings confluent, membranes forming a broad free margin across isthmus; dorsal spines VIII to XI, divergent; skin naked or nearly so. PYGOSTEUS
- bb. Gill-openings restricted, membranes mesially united to isthmus; dorsal spines XI, free; skin mailed, partly mailed, or naked. GASTEROSTEUS
- aa. APELTINÆ. Pubic bones widely separated posteriorly, forming a bony ridge on each side of abdomen between which are ventral fins; dorsal spines IV, divergent; sides not mailed. APELTES

### Genus PYGOSTEUS Gill.

#### The Nine Spined Sticklebacks.

##### **Pygosteus pungitius** (Linnæus).

Ten Spined Stickleback. Many Spined Stickleback.  
Stickleback.

Head  $3\frac{1}{2}$ ; depth  $5\frac{1}{2}$ ; D. X, I, 9; A. I, 10; length of caudal peduncle  $1\frac{2}{3}$  in head; length of caudal  $1\frac{4}{5}$ ; pectoral  $1\frac{3}{5}$ ; ventral spine  $2\frac{2}{5}$ ; snout  $3\frac{1}{2}$  in head, measured from tip of upper jaw; eye  $3\frac{1}{3}$ ; maxillary  $3\frac{1}{2}$ ; interorbital space  $4\frac{1}{4}$ . Body very slender, compressed, and tapering into long, slender caudal peduncle, which is strongly keeled, broader than deep, and much depressed. Head compressed, rather attenuate, and upper profile sloping a little more than lower. Snout rather conic. Eye

rounded, a little anterior. Mouth oblique, and mandible projecting. Maxillary small, not reaching orbit. Teeth minute in jaws. Interorbital space narrow, flat. Gill-rakers rather long and large, in moderate number. Gill-membranes free from isthmus posteriorly. No dermal bony plates along sides. Small plates along bases of dorsal and anal, and on caudal keel. Skeletal plates not covered by skin. Postpectoral plate well developed and striate. Thoracic processes well developed, widely divergent, and forming a U-shaped figure. Bones of skull granulate, surface bones all weak. Pubic bone feeble, not carinated, lanceolate, edge raised, lanceolate and median part thin. First dorsal spine inserted before base of pectoral, tenth a little the larger and longer, and basis of fin a little less than distance from base of last spine to base of caudal. Rayed dorsal inserted nearer base of caudal than posterior margin of eye, elevated anteriorly. Anal similar to rayed dorsal, and spine detached in front. Caudal lunate. Pectoral broad, reaching nearly as far back as tip of ventral spine. Ventral inserted about opposite base of fourth dorsal spine and reaching half way to anal. Color olivaceous above, punctulate and irregularly barred with darker. Below silvery. Length 2 inches. Beesley's Point.

This is the only example I have seen. It is a northern and widely distributed species, abounding in mountain lakes and streams, and in both fresh and brackish waters. Writers refer to it as the nine-spined stickleback, though the above example has ten, a character, together with its slender form, which will at once serve to distinguish it from any other species.

*Pygosteus occidentalis* Abbott, Geol. N. J., 1868, p. 815.

*Pygosteus dekayi* Abbott, l. c.

### Genus GASTEROSTEUS Linnæus.

#### The Two Spined Sticklebacks.

#### **Gasterosteus bispinosus** Walbaum.

Stickleback. Two Spined Stickleback. New York Stickleback.

Head  $3\frac{1}{2}$ ; depth  $4\frac{1}{8}$ ; D. II-I, 1, 10; A. I, 1, 8; scutes 30; mandible  $3\frac{1}{3}$  in head; first dorsal spine 3; first dorsal ray 2;

first anal ray  $2\frac{1}{2}$ ; caudal  $1\frac{7}{8}$ ; length of caudal peduncle 2; pectoral  $1\frac{2}{5}$ ; ventral 2; snout  $3\frac{1}{3}$  in head; eye 3; maxillary  $3\frac{1}{3}$ ; interorbital space  $3\frac{1}{4}$ . Body fusiform, well compressed. Caudal peduncle slender, covered with plates similar to those on body, and furnished with a well-developed keel laterally. Head rather long. Snout long, convex. Eye circular, anterior. Mouth oblique, and mandible well protruding. Maxillary extending barely beyond nostril, not to orbit. Bands of minute teeth in jaws. Interorbital space broadly convex. Opercle finely striate. Gill-rakers  $3+12$ , shorter than filaments and lanceolate. Gill-membranes united to isthmus. Large rugose bony plates on each side of base of dorsal spines. Naked area in front of pectoral large. Pelvic bone lanceolate. Processes from shoulder-girdle below covering most of breast and leaving a narrow naked area between. First two dorsal spines well separated, first longer, and inserted just before origin of pectoral. First interdorsal spinous region  $\frac{2}{3}$  of second. Origin of rayed dorsal nearer base of caudal than eye, and fin anteriorly elevated. Rayed anal begins about first third of base of rayed dorsal, or nearer base of caudal than origin of pectoral, and elevated anteriorly. Anal spine detached. Caudal lunate. Pectoral  $\frac{3}{5}$  of space to anal. Ventral inserted just before second dorsal spine. Spines all serrate, those of anal and soft dorsal small. First dorsal spines joined at base by hinge with basal bony plates, to which they are capable of being firmly set like spines of a cat fish. Color olivaceous, sides silvered or yellow. Length  $2\frac{5}{16}$  inches. Beesley's Point.

I have 2 examples collected many years ago at Beesley's Point by Samuel Ashmead. Dr. Abbott says it is common in Toms River and has been taken in the Delaware as far as Philadelphia.

*Gasterosteus biaculeatus* Abbott, Geol. N. J., 1868, p. 815.

*Gasterosteus noveboracensis* Abbott, l. c.

Genus *APELTES* De Kay.

## The Three Spined Sticklebacks.

*Apeltes quadracus* (Mitchill).

## PLATE 20.

## Stickleback. Three Spined Stickleback.

Head  $3\frac{2}{3}$ ; depth  $4\frac{1}{3}$ ; D. III-I, 11; A. I, 8; dorsal spine  $2\frac{2}{3}$  in head; pectoral  $1\frac{2}{5}$ ; ventral spine 2; length of caudal peduncle  $1\frac{2}{5}$ ; snout  $3\frac{1}{2}$  in head; eye  $3\frac{1}{2}$ ; maxillary  $3\frac{3}{4}$ ; inter-orbital space  $3\frac{2}{3}$ . Body elongate, compressed, and back elevated at beginning of rayed dorsal. Caudal peduncle very slender, long and not keeled. Head compressed and pointed. Snout compressed and pointed. Eye circular, anterior. Mouth little inclined, and mandible projecting a little. Teeth slender, uni-serial. Maxillary not reaching orbit. Interorbital space narrow and a trifle concave. Gill-membranes attached to isthmus, without free edge. Gill-rakers short and sparse. Skin naked. Chest mostly bony. Bare area in front of pectorals small but distinct. Innominate bones not joined on median line but separated, and forming a bony ridge on each side of abdomen below which strong ventral spines are depressible. Innominate bones also wide apart, area between flat, so that a section of fish would be triangular. Scapula forming a small granulated postopercular plate. First dorsal spine inserted before origin of pectoral, longest and strongest, directed to one side. Next two directed to other side at different angles. Space between first and third spines less than space between third and fourth, and first extending beyond base of third. Origin of rayed dorsal about midway between front rim of orbit and base of caudal, and anterior rays elevated. Anal begins a little behind origin of rayed dorsal, and similar. Caudal long and narrow. Pectoral not extending to tip of pubic bone though a little more than half way to anal. Ventral inserted just before base of second dorsal spine, also a trifle less than tip of pubic bone, spine strong subterete, serrate on

both edges, and covered by skin to near tip. When set they point almost sideways, and when depressed they lie inside the innominate bones. Color brownish-olive, mottled with darker and dusky, silvery below. Ventrals of male with bright crimson membrane. Length  $1\frac{7}{16}$  inches. Beesley's Point.

Color in life brownish-olivaceous generally, median line of back and top of head more brownish, and sides more olivaceous. Flanks with blackish mottlings or blotches. Back with about four or five dull or obscure dusky saddle-like blotches. A blackish streak from tip of snout laterally to orbit. Two streaks of same color from behind orbit back along postorbital region of head. Lips dusky, and branchiostegal region same. Body with more or less translucent appearance, and peritoneum showing through abdomen with silvery and brassy reflections. Lower side of head also with similar colored reflections. Pectoral and caudal with dilute amber or gamboge tints. Dorsal brownish, except membranes behind first spine, which are tinted with deep scarlet. Pubic spines whitish. Anal fin dilute brownish. Iris brownish with dull olive reflections. An adult from Crosswicks Creek, near Trenton, May 9th, 1905.

Most abundant of all our fishes in the lower Delaware, particularly in tide-water. In many places they swarm by the thousand among the eel-grass and aquatic vegetation. They are too small to be very dangerous to handle, though some of the larger ones are capable of pricking the skin and causing a little blood to flow by means of their set spines. I have only taken a very few solitary individuals above tide-water.

*Gasterosteus quadracus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 328.

*Apeltes quadracus* Abbott, Geol. N. J., 1868, p. 815.—Abbott, Am. Nat., IV, 1870, p. 115.—Abbott, Nat. Rambles, 1885, p. 478.—Bean, Bull. U. S. F. Com., VII, 1887, p. 146.—Moore, Bull. U. S. F. Com., XII, 1892, p. 360.

### Family FISTULARIIDÆ.

#### The Cornet Fishes.

Body extremely elongate, much depressed, broader than deep. Head very long, anterior bones of skull much produced, forming



a long tube which terminates in the narrow mouth. This tube formed by symplectic, proethmoid, metapterygoid, mesopterygoid, quadrate, palatines, vomer and mesethmoid. Both jaws, and usually vomer and palatines also with minute teeth. Membrane uniting bones of tube below very lax so that tube is capable of much dilation. Gill-membranes separate, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers obsolete. Pseudobranchiæ present. Basibranchial elements wanting. Branchiostegals 5 to 7. Pyloric cœca few. Intestine short. Air-vessel large. Post-temporal co-ossified with cranium. Pectoral ossicles 3. Interclavicles greatly lengthened. Supraclavicles very small. Vertebrae very numerous, first 4 very long. Body scaleless, but having bony plates present on various parts of body, mostly covered with skin. Spinous dorsal entirely absent. Soft dorsal short, posterior somewhat elevated. Anal fin opposite rayed dorsal and similar. Caudal forked, middle rays produced into a long filament. Pectorals small, with a broad base, preceded by a smooth area as in *Gasterosteida*. Ventrals very small, wide apart, abdominal, far in advance of dorsal, and composed of 6 soft rays.

Tropical fishes related to the sticklebacks in structure, but with prolonged snout and different ventral fins. A single species on our coast.

### Genus FISTULARIA Linnæus.

#### The Trumpet Fishes.

##### *Fistularia tabacaria* Linnæus.

##### Trumpet Fish. Pipe Fish.

Head  $2\frac{2}{3}$ ; depth of body about 2 in postocular region; greatest width of body  $1\frac{2}{5}$ ; D. 16; A. 16; mandible  $5\frac{1}{10}$  in head; snout  $1\frac{1}{3}$  in head measured from its own tip; maxillary  $6\frac{1}{2}$  in snout; eye  $7\frac{1}{8}$ ; interorbital space  $7\frac{1}{2}$ ; pectoral  $5\frac{1}{8}$ ; length of depressed dorsal  $3\frac{2}{5}$ ; of depressed anal  $3\frac{1}{8}$ ; upper caudal lobe  $4\frac{3}{5}$ ; length of caudal peduncle  $1\frac{7}{8}$ ; ventral  $1\frac{2}{5}$  in eye. Body very long, slender, depressed. Head long, also depressed. Snout very long,

tapering but little forward, and its lateral edges each with a series of small serrations. Eye elongate, its least depth about  $1\frac{3}{5}$  in its length, and placed about last  $\frac{2}{9}$ . Mouth slightly oblique, lower jaw projecting in front and overlapping upper. Opercles with fine radiating striæ. Bones on cranium finely rugose and several points in front and behind orbit, edges of latter also with some small serræ. Bony interorbital area narrow and a little concave. Lower surface of head finely rugose on bony areas. Gill-opening extending forward to middle of eye. Dorsal inserted about last fourth in space between middle of eye and base caudal, sixth ray longest, and base of fin about half of its length when depressed. Anal opposite and similar. Caudal forked, lobes about equal, and median filament nearly equal to length of head and an eye-diameter. Pectoral a little over a third to ventral which is inserted a trifle behind first third in space between origin of pectoral and that of anal. Color reddish-brown on back marked with numerous large unequal oblong pale blue spots, usually in series. Length  $10\frac{1}{4}$  inches to tip of caudal, and  $13\frac{3}{4}$  to end of filament. Beesley's Point.

I have but 2 examples, the one described above and a smaller one from Squan, though I have seen others from different places along the coast where they do not appear to be uncommon during summer. It is, however, more a feature of the warmer waters of tropical America. When adult it reaches a length of 6 feet.

*Solenostomus tabacarius* Abbott, Geol. N. J., 1868, p. 815.

*Fistularia tabaccaria* Bean, Bull. U. S. F. Com., VII, 1887, p. 146.

*Solenostomus serratus* Abbott, Geol. N. J., 1868, p. 815.

### Sub-Order LOPHOBRANCHII.

#### The Crest Gilled Fishes.

A single family in our waters.

#### Family SYNGNATHIDÆ.

#### The Pipe Fishes.

Body elongate, usually slender. Head slender. Snout long, tube-like, bearing short toothless jaws at end. Gill-openings re-

duced to a small aperture behind upper part of opercle. Body covered with bony plates which are firmly connected, forming a bony carapace. Tail long, prehensile or not, usually provided with a small caudal fin. Males with an egg-pouch, usually placed on under surface of tail, sometimes on abdomen, and commonly formed of 2 folds of skin which meet on median line. Eggs are received into this pouch and retained until some time after hatching, when pouch opens, permitting young to escape. Dorsal fin single, nearly median, of soft rays only. Anal fin minute, usually present. Pectorals small or wanting. Ventrals none.

Small fishes, sometimes in fresh waters, and found in all warm seas.

### *Key to the genera.*

- a. Tail not prehensile, usually a caudal fin; axis of head usually in line with axis of body. SYNGNATHUS
- aa. Tail prehensile, caudal fin small; head shaped like that of a horse, placed at large angle with axis of body. HIPPOCAMPUS

### Genus SYNGNATHUS Linnaeus.

#### The Pipe Fishes.

##### *Syngnathus fuscus* Storer.

#### Pipe Fish. Green Pipe Fish. Bill Fish.

Head  $8\frac{1}{8}$ ; head and trunk  $1\frac{2}{5}$  in rest of body to base of caudal; depth  $3\frac{3}{4}$  in head; D. 38; rings  $19 + 38$ ; snout 2 in head measured from its own tip; eye  $2\frac{4}{5}$  in snout; interorbital space about  $1\frac{2}{3}$  in orbit longitudinally; anal  $1\frac{1}{2}$ ; least depth of caudal peduncle  $1\frac{2}{3}$ ; base of dorsal a trifle greater than head; pectoral  $3\frac{3}{4}$ ; caudal  $2\frac{7}{8}$ . Body very elongate and slender, 7-angled, and with tapering long tail. Median ridge laterally and below well keeled. Head slender, tapering, median line above and below well keeled. Eye a little ellipsoid and posterior. Jaws toothless. Mouth oblique and mandible protruding. Median rostral keel conspicuous, edge finely serrate, and extending to interorbital space. Interorbital space concave. Occiput, nu-

chal plates and opercle striate. Rings all well striate. Origin of dorsal a little behind first third in length of fish, on 4 body and 6 caudal rings, and height of fin about  $1\frac{3}{5}$  in snout. Caudal rounded. Color olivaceous above, paler beneath. A dark streak along side of head. Length  $6\frac{3}{8}$  inches. Sea Isle City.

Color of the above in life or when fresh, dull olive-brownish above, and becoming paler on sides. At every fourth ring a darker or more olive-brown streak across back. A dusky-brown streak along side of snout to eye and then continued back from eye to base of pectoral, the color above well merged into the pale brown of the median portion of head. A pale brownish streak obliquely back from eye on side of head. Iris pale brassy, the dark lateral streak passing through and blotch due to posterior streak, also a faint blotch anteriorly of deep brown. Lips brownish, and lower surface of beak brownish becoming pale and translucent till reaching lower process. Each side of head below, or opercle and infero-pectoral region, tinted pale brassy or purplish. Lower surface of body pale brownish or whitish, that of tail darker. Dorsal and caudal brownish, caudal perhaps a little darker. Another example with similar data is more pale brownish, almost uniform above, and the abdomen and lower surface of head more brassy. Iris also more brassy. Opercle with greenish sheen.

My examples from Beesley's Point, also 2 small examples from the surf at Stone Harbor, and others from Atlantic City in the eel-grass. The Stone Harbor examples were dark brown in life.

*Siphostoma fuscum* Bean, Bull. U. S. F. Com., VII, 1887, p. 134.—Moore, Bull. U. S. F. Com., XII, 1892, p. 360.—Bean, Bull. Am. Mus. N. H., IX, 1897, p. 356.

*Syngnathus viridescens* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 351.

*Syngnathus peckianus* Abbott, Geol. N. J., 1868, p. 827.—Verrill, Am. Nat., V., 1871, p. 398.

## Genus HIPPOCAMPUS Rafinesque.

## The Sea Horses.

*Key to the species.*

a. Dorsal 19, on  $3\frac{1}{2} + 0$  rings; body mottled, not dotted. HUDSONIUS

aa. Dorsal 17 or 18, on 2 caudal rings; light blue spots on head and snout.

PUNCTULATUS

- *Hippocampus hudsonius* De Kay.

## PLATE 21.

## Sea Horse. Horse Fish.

Head  $1\frac{7}{8}$  in trunk measured over back from gill-opening; depth of trunk  $1\frac{5}{6}$ ; width of trunk 4; trunk 2 in tail; D. 19; A. 4; P. 15; rings  $11 + 37$ ; depth of head, at coronet,  $1\frac{3}{5}$  in length; width of head  $2\frac{3}{5}$ ; snout  $2\frac{3}{4}$ ; eye  $6\frac{1}{8}$ ; base of dorsal  $1\frac{3}{5}$ ; interorbital space  $1\frac{1}{2}$  in eye. Body deep, trunk short and compressed. Tail tapering, quadrangular, and with rather robust point. Head deep, compressed. Snout a little long, and profile deeply concave posteriorly. Eye small, rounded, and a trifle anterior. Mouth small, terminal, superior, and with jaws conspicuously protruding. Interorbital space forming isocles triangle directed in front of eyes. Gill-opening small, lateral, opening upward, high and close to nape near nuchal keel. Coronet high, its upper surface concave, with 2 lateral and 1 posterior tubercles, also an elevated prominence springing from ridge in front furnished with a tubercle anteriorly. Below latter on each side of head a tubercle. Interorbital space with each edge of triangle continued as bony ridges till over eye posteriorly where they form a superorbital tubercle. Shoulder-girdle with 3 tubercles. Bones on head striate. Rings with concave surfaces with well-developed tubercles but becoming obsolete as they progress on tail. Fins with simple rays, dorsal rather low, beginning in front of tenth ring and extending on second caudal ring. Anal small, short, on first caudal ring. Pectoral with a broad base, rays rather short. Dusky, nearly uniform. Dorsal with a dark submarginal band. Length about 6 inches. Beesley's Point.

I have 3 examples, one from Point Pleasant, which are positively this species. Others from Cape May and Ocean City have about 17 dorsal rays respectively. They do not differ however in any respect other than that which may be attributed to individuals. None of my examples show any traces of fine white spots, apparently the only reliable character for the determination of *Hippocampus punctulatus*. Young examples of *H. hudsonius* show the tubercles on the body-rings alternately more or less enlarged. Sea horses are quite common at times on our coast and have frequently been taken near Atlantic City. They frequently occur about grass to which they cling by means of their prehensile tails.

*Hippocampus hudsonius* Lockwood, Am. Nat., I, 1867, p. 226.—Abbott, Geol. N. J., 1868, p. 828.—Moore, Bull. U. S. F. Com., XII, 1892, p. 360.

*Hippocampus heptagonus* Lockwood, Am. Nat., XXI, 1887, p. III.

#### ***Hippocampus punctulatus* Guichenot.**

#### Horse Fish.

Dorsal of female with yellow margin, of male orange, and in both a submarginal band, and also a dark blotch at top of anterior dorsal rays. One male had body rings with dark brown vertical stripes. A female had wider stripes on throat converging behind, flanked in front by a few irregular dark blotches, and behind by 4 interrupted lines. White punctulations most numerous posteriorly. All have several linear stripes obliquely across opercles and eye, and usually 2 on neck. Abdominal edge dark. Late in August those taken at Ocean City had greatly developed cirri, and the males were with fully distended pouches. (Bean.)

I have no other record of this fish on the New Jersey coast, except that by Dr. Bean, who speaks of it as rather abundant about Ocean City and Somers Point. It has not been recorded so far to the north before. From the well-known species, *Hippocampus hudsonius*, it may be distinguished by the light dots.

*Hippocampus punctulatus* Bean, Bull. U. S. F. Com., VII, 1887, p. 134.

## Sub-Order PERCOMORPHI.

## The Perch Like Fishes.

*Key to the Families.*

- a. (Scombroidei.)* Caudal peduncle slender, usually with a widely forked caudal.
- b.* Last dorsal and anal rays as series of finlets. SCOMBRIDÆ
- bb.* No finlets.
- c.* No caudal; body band-shaped. TRICHIURIDÆ
- cc.* Caudal present; body not band-shaped.
- d.* Snout produced in a sword. XIPHIIDÆ
- dd.* Snout not produced.
- e.* A spinous dorsal.
- f.* Œsophagus without tooth-like processes.
- g.* Dorsal spines connected by membrane, sometimes obsolete with age; body short to orbicular.
- h.* Scales minute or obsolete, cycloid, those along lateral line sometimes armed; tail deeply forked. CARANGIDÆ
- hh.* Scales moderate or weakly ciliate, never armed along lateral line; tail not deeply forked. POMATOMIDÆ
- gg.* Several free dorsal spines; body elongate; scales small; caudal little forked. RACHYCENTRIDÆ
- ff.* Œsophagus armed with tooth-like processes.
- i.* Spinous dorsal and ventrals rudimentary or absent. STROMATEIDÆ
- ii.* Spinous dorsal and ventrals present. CENTROLOPHIDÆ
- ee.* No spinous dorsal, all rays branched and articulate. CORYPHÆNIDÆ
- aa. (Percoidea.)* Caudal peduncle deep, usually with short obtuse caudal.
- j.* Vent anterior, or at throat in adult. APHREDODERIDÆ
- jj.* Vent posterior, as usual in most fishes.
- k.* Maxillary not sheathed by preorbital, or only covered by edge of latter; accessory ventral scale small or wanting; opercle usually ending in a spine.
- l.* Precaudal vertebrae with transverse processes from third to fourth to last; ribs all but last 1 to 4 sessile, inserted on centra behind transverse processes; anal spines III or more; pseudo-branchiae rudimentary, covered by skin. CENTRARCHIDÆ
- ll.* Precaudal anteriorly without transverse processes; all or most of ribs inserted on transverse processes when these are developed.

- m.* Anal spines I or II, very rarely obsolete. PERCIDÆ  
*mm.* Anal spines III or more, never II or I.  
*n.* Vomer and palatines usually with teeth.  
*o.* Anal shorter than dorsal; head not covered everywhere with rough scales. SERRANIDÆ  
*oo.* Anal scarcely shorter than dorsal and similar; head and body everywhere covered with rough scales. PRIACANTHIDÆ  
*nn.* Vomer without teeth, body deep, compressed. LOBOTIDÆ  
*kk.* Maxillary slipping for most its length under edge of preorbital, which forms a more or less distinct sheath; accessory ventral scale present; opercle without spines.  
*p.* Anal spines III.  
*q.* Mouth moderately protractile.  
*r.* Vomer with teeth. LUTIANIDÆ  
*rr.* Vomer without teeth.  
*s.* Lateral teeth not molar. HÆMULIDÆ  
*ss.* Lateral teeth molar. SPARIDÆ  
*qq.* Mouth exceedingly protractile. GERRIDÆ  
*pp.* Anal spines II, I or absent.  
*t.* Premaxillaries without blunt posterior canine.  
*u.* A pair of long mandibular barbels. MULLIDÆ  
*uu.* No mandibular barbels. SCIÆNIDÆ  
*tt.* Premaxillaries usually with a blunt posterior canine. LATILIDÆ

### Family SCOMBRIDÆ.

#### The Mackerels.

Body elongate, fusiform, not much compressed. Caudal peduncle extremely slender, keeled. Head subconic, pointed anteriorly. Mouth rather large, with lateral cleft. Premaxillary not protractile. Maxillary without supplemental bone. Jaws with sharp teeth, large or small. Vomer and palatines toothed or not. Preopercle entire. Opercle unarmed. In very young preopercle armed with radiating spines, which are later absorbed and lost. Gill-openings very wide, membranes not united, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers usually long.



Pseudobranchiæ present, large. Branchiostegals 7. Air-vessel small, sometimes present. Stomach sac-shaped. Pyloric cœca numerous. First upper pharyngeal present, without teeth. Second with teeth, and third and fourth co-össified, with teeth. Lower pharyngeals separate. Vertebrae 31 to 66, in greater number than in *Carangidæ*. Body covered with minute cycloid scales, and anteriorly sometimes forming a corselet. Lateral line present, its course undulate. Dorsal fins 2, first of rather weak spines, depressible in a groove, second similar to anal, and elevated anterior lobe always distinct. Last rays of dorsal and anal detached and separate, forming in each case a series of finlets. Caudal lobes abruptly diverging, falcate and fin adapted to rapid motion. Anal spines weak. Ventrals I. 5, well developed, thoracic. Coloration metallic, often brilliant, and prevailing shade steel blue.

Fishes of high seas, many cosmopolitan, and all having a wide range. Most are valued as food-fishes, the flesh firm and oily, but sometimes coarse.

### *Key to the genera.*

- a.* SCOMBRINÆ. Caudal peduncle without median keel on each side; pectoral inserted high, on level of eye. SCOMBER
- aa.* SARDINÆ. Caudal peduncle with median keel, a small keel above and 1 below this; pectoral usually inserted below eye.
  - b.* Body scaleless, excepting about lateral line and corselet. PELAMYS
  - bb.* Body wholly covered with small scales, those on corselet and lateral line sometimes larger.
    - c.* Teeth of jaws slender, subconical, little if at all compressed; gill-rakers numerous; corselet distinct; pectorals inserted low. THUNNIS
    - d.* Vomer and palatines with villiform or sand-like teeth; body robust, compressed. THUNNIS
    - dd.* Vomer toothless; body elongate, slightly compressed. SARDA
  - cc.* Teeth in jaws strong, subtriangular or knife-like and compressed; corselet obscure; pectorals inserted near level with eye. SCOMBEROMORUS

### Genus SCOMBER Linnæus.

#### The Mackerels.

#### *Key to the species.*

- a.* Sides below median line of body opaque silvery. SCOMBRUS
- aa.* Sides below median line of body in adult mottled. COLIAS

*Scomber scombrus* Linnæus.

## Mackerel. Boston Mackerel.

Principally distinguished from the next by the sides of the body below the median line being immaculate silvery, larger size, and dorsal spines X or XII.

It is abundant at times off our coast, and I have frequently seen it from Cape May. One of the best known of food-fishes, and reaching a length of 18 inches. Mitchill originally described this, the American form, from off Sandy Hook. Dr. H. M. Smith says it occurs regularly in the spring, a fact which I have so far

Mackerel. *Scomber scombrus* Linnæus.

been able to observe to some extent about Cape May. Though I have never seen them during the summer, catches have been reported. They are said to occur also in the fall. Scarce about Cape May, according to reports. Sometimes a school is taken in the deep-sea pounds in the fall. They run small, and are mostly number twos. It has not yet been taken in Delaware Bay.

*Scomber scombrus* Smith, Bull. U. S. F. Com., XII, 1892, p. 372.

*Scomber vernalis* Mitchill, Tr. Lit. Philos. Soc. N. Y., 1815, p. 423.—Abbott, Geol. N. J., 1868, p. 812.

*Scomber colias* Gmelin.

Mackerel. Thimble Eye Mackerel. Fall Mackerel. Chub Mackerel.

Head  $3\frac{5}{6}$ ; depth 5; D. X-I-I, 10, 5; A. I-I, 11, 5; width of head  $1\frac{7}{8}$  in its length; depth of head over posterior margin of eye  $1\frac{7}{8}$ ; snout  $3\frac{1}{6}$ ; eye  $4\frac{1}{6}$ ; maxillary  $2\frac{4}{7}$ ; interorbital space  $3\frac{1}{3}$ ; second dorsal spine 2; second dorsal ray  $4\frac{1}{8}$ ; first anal ray  $4\frac{1}{4}$ ; upper caudal lobe  $1\frac{3}{4}$ ; pectoral 2; ventral  $2\frac{1}{3}$ ; least depth of caudal peduncle  $7\frac{3}{4}$ . Body fusiform, elongate, little compressed, and rather plump. Caudal peduncle slender, without keel. Head pointed, compressed. Snout conic. Eye circular,



Chub Mackerel. *Scomber colias* Gmelin.

with broad adipose eyelids. Mouth rather large, inclined, and jaws about even. A single row of small slender teeth in each jaw and on vomer and palatines. Interorbital space broadly convex, flattened medianly, and with rather large translucent area anteriorly, also with 2 parallel bony ridges. Subopercle more elliptical than triangular. Gill-rakers  $10+25$ , strong, spinescent, a little less than longest filaments and about  $1\frac{1}{4}$  in orbit. Inside of gill-opening with a depression on shoulder-girdle below. Large radiating scales at posterior border of eye. Lateral line slightly wavy. Spinous dorsal inserted nearer tip of snout than origin of rayed dorsal, and second spine longest. Rayed dorsal inserted nearer origin of spinous dorsal than base of caudal, first

rays longest. Anal opposite rayed dorsal and similar, and both fins covered densely with small scales. Caudal small, forked, and base of each lobe with a keel. Pectoral broad, short, reaching about opposite base of fourth dorsal spine. Ventral inserted a little behind pectoral, and  $\frac{1}{3}$  of space to anal. Back blue-black, with about 30 waved darker streaks extending to just below lateral line. Belly and sides silvery, latter with dusky spots or mottlings. Base of pectoral blackish. Length  $8\frac{1}{4}$  inches. Sea Isle City.

When fresh in spirits back and upper surface of head deep blue-black, with beautiful metallic and iridescent reflections, though the former color fading afterwards in some examples to more or less hyaline shades of greenish-blue. Back with vermiculating and other streaks of darker shades than body-color, between fins or down back medianly they are more or less vermiculating while on sides above they slope forward. Lower surface of body white, line of demarcation between color of back very pronounced, and most of its area overshot with bronzed or brassy reflections. Just below color of back, on whitish of side, dull bronzed or brassy-olive spots and blotches rather obscurely defined, and varying in individuals, in some presenting a more or less concealed and soiled appearance well over the sides of abdomen. Sides of head well up on postocular region, jaws, except upper anteriorly and tip of mandible, silvered white. Dorsals, caudal and pectoral more or less transparent brownish to dusky. Pectoral deepest basally, with a pale spot below. Ventrals and anal whitish. Iris whitish with grayish above. Inside of mouth translucent grayish.

Mr. Wm. J. Fox obtained this fish at the above locality where it was not rare. Although smaller than the common mackerel it is an important food-fish.

*Scomber colias* Moore, Bull. U. S. F. Com., XII, 1892, p. 360.  
—Smith, Bull. U. S. F. Com., XII, 1892, p. 373.

*Scomber grex* Abbott, Geol. N. J., 1868, p. 812.

*Scomber pneumatophorus* Bean, Bull. U. S. F. Com., VII, 1887, p. 138.

Genus PELAMYS Walbaum.

The Little 'Tunnies.

*Pelamys alleterata* (Rafinesque).

PLATE 22.

Apple Core. Albacore.

Among our mackerels with a naked body, excepting the scaly corselet, this one is distinguished by its continuous dorsal fins.

Apparently a pelagic form of warmer waters. It is apparently rather scarce according to Dr. Smith. They are not valued much as food-fish.

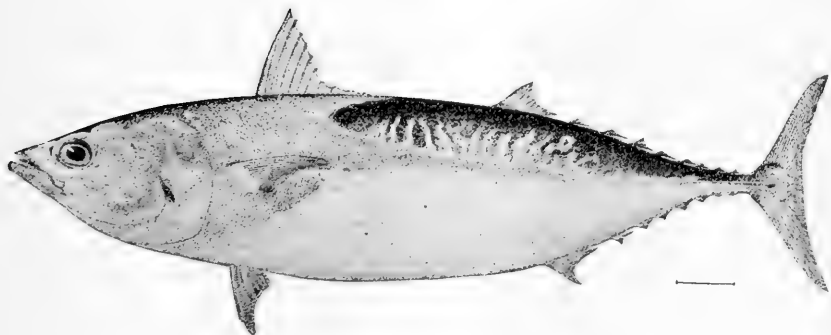
*Gymnosarda alletterata* Smith, Bull. U. S. F. Com., XII, 1892, p. 371.

Genus THUNNUS South.

The Great Tunnies.

*Thunnus thynnus* (Linnæus).

Tunny. Great Tunny.



Great Tunny. *Thunnus thynnus* (Linnæus).

Among the scaled mackerel-like fishes this one has villiform or sand-like teeth on the vomer or palatines, and those in jaws sub-conical or little compressed, corselet distinct, and pectoral short or not reaching much beyond tip of moderate ventral.

Largest of the mackerels reaching 10 feet or more in length and weighing 150 pounds. A pelagic fish on all warm coasts, and an excellent food-fish. The only occurrence on our coast I noted concerned a large example examined in the Philadelphia market. It was taken near Brighton in the ocean, November 4th, 1898.

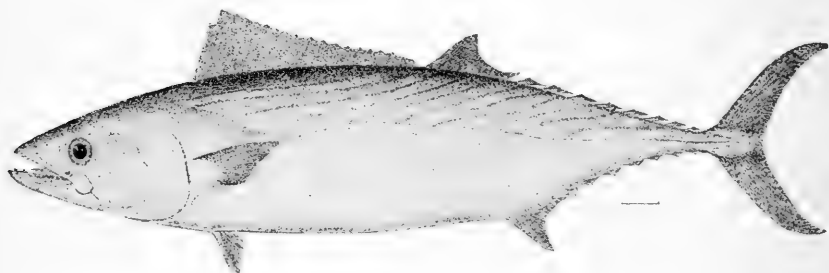
*Thunnus thynnus* Fowler, Science, XVII, April 10, 1903, p. 594.

### Genus SARDA Cuvier.

#### The Bonitos.

#### *Sarda sarda* (Bloch).

Bonito. Bone Jack. Bone Eater. Skip Jack.



Bonito. *Sarda sarda* (Bloch).

Head  $3\frac{7}{8}$ ; depth  $4\frac{1}{6}$ ; D. XXI-IV, 12, 8; A. IV, 11, 7; width of head  $1\frac{5}{6}$  in its length; depth of head over posterior margin of orbit  $1\frac{3}{4}$ ; snout 3; eye 7; maxillary 2; interorbital space  $3\frac{1}{6}$ ; third dorsal spine  $2\frac{5}{6}$ ; first branched dorsal ray  $3\frac{1}{4}$ ; first branched anal ray  $3\frac{1}{4}$ ; pectoral  $2\frac{1}{10}$ ; ventral  $3\frac{1}{2}$ ; greatest width of caudal peduncle 5. Body robust, moderately compressed, and elongate. Head large, compressed and pointed. Snout long and conic. Eye small, circular and with rather narrow adipose eyelid. Mouth large and jaws even. Teeth rather strong, slightly compressed in jaws, also on palatines, but none on vomer. Maxillary not concealed, reaching a little beyond orbit and its posterior expansion a trifle over half of same. Interorbital

space broadly convex. Gill-rakers  $4 + 12$ , slender, strong, and a trifle less than orbit. Corselet distinct, small, not extending beyond pectoral. Lateral line slightly undulating and without decided curve in its course. Side of caudal peduncle with a broad cutaneous keel. Spinous dorsal begins before pectoral, long, low, graduated from fourth or longest spine so that it slopes down gradually posteriorly. Interdorsal region short. Rayed dorsal inserted nearer base of caudal than orbit, and anterior branched rays longest. Anal similar, though inserted more posterior. Finlets similar, last ones smallest. Rayed dorsal and anal, and base of caudal, densely scaled, latter with 2 longitudinal keels basally. Caudal widely lunate, lobes even. Pectoral short and broad. Ventral inserted about opposite origin of pectoral and  $1\frac{1}{2}$  in same fin. Back dark steel-blue with numerous darker or slaty stripes downward and forward from median line. Lower surface silvery. Dorsals dusky or slaty. Length 22 inches. Long Branch.

Color of the above when freshly caught steel-bluish-slaty above, corselet and median line of back darker, or more blackish and with greenish reflections. Top of head, but not snout, with blackish like corselet. Pupil slaty-black and adipose eyelid similar. Iris rather narrowly brassy. Back with steel-slaty-gray and blue reflections, and side behind pectoral with slight brassy tints. Head, and corselet about pectoral, more grayish with a slight tinge of lavender. Jaws slightly ruddy. Inside of mouth blackish. Lines or sutures of jaw and maxillary olive-gray or slaty. Inside of gill-opening grayish or soiled white. Lower or ventral region of body opaque white. Side of body gray, burnished in some lights slightly with silvery and pale brassy. Darker lines on back in some lights plumbeous, and in others pale olive. Dorsals slate-color, deeper distally, and spinous fin with upper portion almost black anteriorly. Anterior edge of rayed dorsal lobe pale brown. Finlets, both above and below, slate-colored, and paler on anterior margins. Caudal pale brownish, basally with greenish, yellowish and purplish reflections. Caudal peduncle with keel darker above, olivaceous, and below paler or whitish. Anterior margin of soft anal broadly pale or whitish, rosy-tinted, and rest of fin plumbeous or slaty, at least distally.

Pectoral greenish-slaty inside, outside grayish-plumbeous basally, and marginally slaty, becoming quite dark on lower or posterior edge. Ventral more or less chalky, especially inside, while outer portions are brownish. Large schools of these fish, all running about the same size were taken off here prior to this time during the summer.

I only have this fish from the above locality, though I have seen it at Cape May, Stone Harbor and Sea Isle City, where it is abundant at times. It reaches a length of  $2\frac{1}{2}$  feet and will weigh 11 or 12 pounds. As a food-fish it is fair, though not of fine quality. It is an inhabitant of the open sea and is said to approach the shores for food and to spawn. At Cape May 1 or 2 are taken on a line during each week of the season, though they are active and difficult to capture. They run about 8 or 9 pounds and never occur in Delaware Bay.

*Pelamys sarda* Abbott, Geol. N. J., 1868, p. 812.

*Sarda sarda* Bean, Bull. U. S. F. Com., VII, 1887, p. 138.—Moore, Bull. U. S. F. Com., XII, 1892, p. 360.—Smith, Bull. U. S. F. Com., XII, 1892, p. 371.

### Genus SCOMBEROMORUS Lacépède.

#### The Spanish Mackerels.

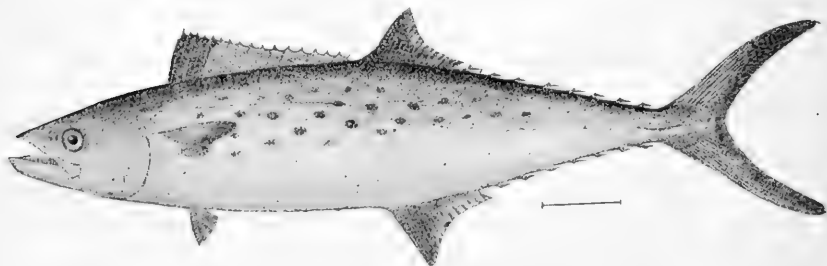
#### *Key to the species.*

- a.* Soft dorsal inserted in advance of anal.  
*aa.* Soft dorsal inserted over anal.

MACULATUS  
 REGALIS

#### ***Scomberomorus maculatus* (Mitchill).**

Spanish Mackerel. Spaniard. Spotted Cybium.



Spanish Mackerel. *Scomberomorus maculatus* (Mitchill).



Head  $4\frac{3}{4}$ ; depth  $4\frac{1}{2}$ ; D. XIX, v, 13, 1, 8; A. iv, 14, 1, 8; snout  $2\frac{2}{3}$  in head; eye  $6\frac{1}{8}$ ; maxillary  $1\frac{1}{5}$ ; interorbital space  $3\frac{1}{8}$ ; pectoral  $1\frac{3}{5}$ ; least depth of caudal peduncle  $4\frac{1}{8}$ ; teeth  $\frac{21}{18}-\frac{19}{18}$ . Body elongate, strongly compressed, and profiles similarly convex. Head compressed, pointed. Eye circular, anterior. Mouth large, curved a little obliquely. Maxillary reaching a little past orbit, and its distal expansion about  $\frac{4}{7}$  of same. Teeth large, compressed and sharp. Posterior nostril nearer eye than anterior, deeply slit-like, and anterior near last fourth in length of snout. Interorbital space convex. Gill-rakers 3+10, longest about  $\frac{4}{7}$  of orbit. Scales very fine, imbedded, behind eye enlarged, and on cheek lanceolate. Lateral line undulated, and forming a broad scaly keel on side of caudal peduncle. Spinous dorsal inserted nearer tip of snout than origin of caudal, or a little behind that of pectoral. Rayed dorsal inserted a little nearer base of caudal than tip of snout, anteriorly high and forming a lobe graduated down from first branched rays. Anal similar, inserted a little more posterior. Finlets uniform. Caudal widely lunate, base of each lobe with a keel. Pectoral short, about half way to rayed dorsal. Ventral smaller, and inserted about opposite origin of spinous dorsal. Color bluish above, and everywhere more or less silvered. Sides with elliptical blotches of dull orange. Spinous dorsal whitish at base, black marginally. Rayed dorsal yellowish, margins black. Anal white. Caudal dusky. Pectoral black posteriorly, from side yellowish with black borders. Length 17 inches. Beesley's Point.

Among the finest of food-fishes, reaching a weight of 9 pounds. On our coast it is rather irregular, in schools of small size.

*Cybium maculatum* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 345.

*Apodontis maculatus* Abbott, Geol. N. J., 1868, p. 812, evidently from Baird.

*Scomberomorus maculatus* Bean, Bull. U. S. F. Com., VII, 1887, p. 131.—Smith, Bull. U. S. F. Com., XII, 1892, p. 370.

*Scomber dekayi* Abbott, Geol. N. J., 1868, p. 812.

*Scomberomorus regalis* (Bloch).

Cero. Sier. Siering. Searer.

Among the scaly spanish mackerels with strong knife-like teeth in the jaws, this one is distinguished by having the soft dorsal inserted over the anal.

An example was reported to Mr. Wm. J. Fox in 1905 from off Sea Isle City estimated to have weighed 65 pounds. It is an excellent food-fish, more abundant in tropical waters, and to be considered rather scare on our coast.

Cero. *Scomberomorus regalis* (Bloch).

*Scomberomorus regalis* Smith, Bull. U. S. F. Com., XII, 1892, p. 370.

## Family TRICHIURIDÆ.

The Cutlass Fishes.

Body extremely elongate, band-shaped, and tapering to a point. Mouth wide, jaws armed with strong unequal teeth. Premaxillaries not protractile. Gill-membranes separate, free from isthmus. Gills 4, a slit behind fourth. Pseudobranchiæ present. Air-bladder present. Pyloric cœca numerous. Vertebrae in greatly increased number, about 160. Body naked. Lateral line present. Dorsal fin very low, long, usually continuous, rays all similar or spinous, and soft parts not differentiated. Anal fin very long and low, scarcely rising above surface of skin. Ventral fins imperfect or wanting, thoracic. Caudal fin absent.

Surface-fishes of the tropical seas. One species on our coast.

## Genus TRICHIURUS Linnæus.

## The Hair Tails.

## PLATE 23.

**Trichiurus lepturus** (Linnæus).

## Cutlass Fish. Hair Tail. Ribbon Fish.

Head  $7\frac{2}{3}$ ; depth  $15\frac{1}{2}$ ; D. 134; A. CVII; mandible 2 in head; pectoral  $3\frac{1}{6}$ ; fiftieth dorsal ray  $2\frac{1}{2}$ ; snout  $2\frac{2}{5}$  in head measured from tip of upper jaw; eye 7; maxillary  $2\frac{2}{5}$ ; interorbital space 7. Body extremely elongate, band-like, and tapering to a very slender tail. Head long with wide mouth. Snout long, pointed, and curved a little. Eye circular, high and a trifle anterior. Mandible well protruding and with a horny tip. Maxillary reaching past front of pupil and its distal expansion a little less than latter. Jaws armed with very strong knife-like unequal teeth, upper with 4 long strongly compressed barbed fangs. Palatine teeth uniserial, small, none on vomer. Nostrils a little above center, but close to front rim of orbit. Interorbital space a little convex. Gill-rakers  $10 + 15$ , short, slender sharp-pointed, and some with small pointed basal cusps. Gill-filaments longer, equal about diameter of pupil. Body naked. Lateral line curving down after pectoral and then concurrent with ventral profile. Dorsal inserted nearly midway between middle of orbit and origin of pectoral, fin highest in middle of its length, though soon sloping down behind. Anal inserted about first  $\frac{3}{8}$  in entire length of fish, of short imbedded spines and first but trifle larger than those following. No caudal. Pectoral short and pointed. Color bright silvery. Dorsal grayish marginally, dusky anteriorly. Length  $38\frac{1}{4}$  inches. Beesley's Point.

I have 2 examples from the above locality taken many years ago, though the species has been reported to me from the deep-sea pounds off various points along our coast several times. Other examples are from Barnegat, Atlantic City and Cape May.

*Lepturus argenteus* Abbott, Geol. N. J., 1868, p. 812.

## Family XIPHIIDÆ.

## The Sword Fishes.

Body elongate. Upper jaw very much prolonged, forming a "sword," which is flattened horizontally and composed of the consolidated vomer, ethmoid and premaxillaries. Teeth wanting in adult, present in young. Gills of peculiar structure, laminæ of each arch joined into 1 plate by reticulations. Gills 4, a slit behind fourth. Gill-membranes separate, free from isthmus. Pseudobranchiæ present. Branchiostegals 7. Air-vessel present. Pyloric cœca very numerous. Intestinal canal long, with many folds. Vertebrae short,  $14 + 12 = 26$  in number, neural and hæmal spines normal. Ribs very few. Skin naked, young covered with rough granulations. Very young or larval individuals differing much from adults, fins high, both jaws prolonged into a beak, and head armed with long spines. Dorsal fin long, usually divided in adult, continuous in young, without differentiated spinous part, both parts composed of soft rays, posterior portion much smaller than anterior and placed on tail resembling second dorsal of shark, and fin rays enveloped in skin. Anal fin divided in adult. Caudal peduncle slender, with strong median keel. Caudal fin widely forked in adult. Ventral fins entirely wanting, no pelvic arch.

A single species, an enormous fish in the open sea rivaling the largest sharks in size and of immense strength of muscle. Occasional on our coast.

## Genus XIPHIAS Linnæus.

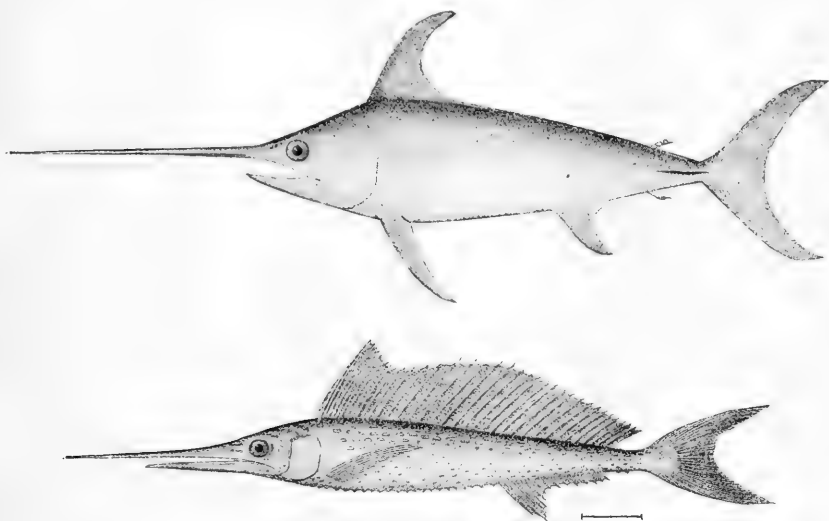
## The Sword Fishes.

*Xiphias gladius* Linnæus.

## Sword Fish.

Distinguished from any of our other fishes by the prolonged snout, which is very long, pointed, flattened and trenchant.

Known to me from 2 records of Mr. H. Walker Hand. The first was taken during the summer of 1901, a large example,



Sword Fish. *Xiphias gladius* Linnæus.  
(Upper figure adult, lower young.)

which was allowed to rot. The sword sold for ten dollars. The other was reported in December of 1904, both from Cape May.

*Xiphias gladius* Abbott, Geol. N. J., 1868, p. 814.

### Family CARANGIDÆ.

#### The Pampanos.

Body more or less compressed and often elevated. Head compressed, occipital keel prominent, usually trenchant. Mouth of varying size, dentition various, teeth, generally small. Premaxillaries usually protractile. Maxillary with or without supplemental bone. Preopercle usually entire in adult, in very young armed with 3 or more spines. Gill-openings very wide, membranes usually not united, free from isthmus. Gills 4, a slit behind last. Gill-rakers usually long. Pseudobranchiæ large, present in all our genera, often disappearing with age. Branchiostegals commonly 7. First superior pharyngeal without teeth,

second, third and fourth separate with teeth. Lower pharyngeals separate. Air-vessel present, often bifurcate behind. Œsophagus unarmed. Pyloric cæca generally numerous. Vertebrae fewer than in *Scombridae*, usually  $10 + 14 = 24$ . Body sometimes naked, or more usually covered with thin small cycloid scales. Lateral line complete, anteriorly arched, and posterior part straight, sometimes armed with bony plates. Dorsal fins more or less separated, spinous part rather weak, and spines usually depressible in a groove. Anal long, similar to soft dorsal, always preceded by 2 stiff spines usually separate. In young more or less connected with fin or with each other. These sometimes disappear with age, and sometimes spinous dorsal also vanishes. Often a procumbent spine before dorsal. Pectoral narrow. Ventrals thoracic, well developed, I, 5. Caudal widely forked. Coloration chiefly metallic and silvery or golden.

A large group of swift-swimming fishes, often with the dorsal fin above the surface of the water. Many are widely distributed and nearly all valued as food.

### *Key to the genera.*

- a. SERIOLINÆ.* Anal fin much shorter than soft dorsal, its base not longer than abdomen.
- b.* Membrane of dorsal spines disappearing with age. NAUCRATES
- bb.* Membrane of dorsal spines persistent. SERIOLA
- aa.* Anal fin about as long as soft dorsal, its base longer than abdomen.
- c.* Maxillary with a supplemental bone; lateral line arched anteriorly, usually armed posteriorly; pectoral long, falcate.
- d. CARANGINÆ.* Dorsal outline more strongly curved than ventral outline.
- e.* Lateral line with scutes.
- f.* Body oblong or more or less elevated; lateral line with scutes on its straight posterior portion only, sometimes very few and small, especially in those with much compressed body.
- g.* Dorsal and anal with a detached finlet. DECAPTERUS.
- gg.* No finlets.
- h.* Teeth of jaws in a few series or in 1 series, unequal, or at least not forming villiform bands, outer series above usually enlarged, lower teeth usually uniserial. CARANX
- hh.* Teeth of jaws equally small or wanting, forming villiform bands if present. ALECTIS

- ff.* Body broad ovate, very strongly compressed, its outlines everywhere trenchant, anterior profile nearly vertical; scutes almost obsolete. VOMER
- cc.* Lateral line without any scutes; body short and elevated, strongly compressed. SELENE
- dd.* CHLOROSCOMBRINÆ. Dorsal outline less strongly curved than ventral; body much compressed, its outlines everywhere trenchant; armature of lateral line obsolete or nearly so. CHLOROSCOMBRUS
- cc.* TRACHINOTINÆ. Maxillary without supplemental bone; anal fin similar to soft dorsal, its base much longer than abdomen; tail unarmed; pectoral short, not falcate. TRACHINOTUS

## Genus NAUCRATES Rafinesque.

## The Pilot Fishes.

**Naucrates ductor** (Linnæus).

PLATE 24.

Pilot Fish.

This fish closely resembles the next but may be distinguished by having the membrane of the dorsal spines disappearing with age.

This pelagic species is apparently rare. The very young are furnished with a strong opercular spine, and the dorsal spines connected by membrane.

*Naucrates ductor* Abbott, Geol. N. J., 1868, p. 814.

## Genus SERIOLA Cuvier.

## The Amber Fishes.

*Key to the species.*

*a.* Dorsal rays 38 or 39.

*aa.* Dorsal rays 34.

ZONATA

LAIANDI

**Seriola zonata** (Mitchill).

PLATE 25.

Shark's Pilot. Pilot Fish. Banded Seriola.

Head  $3\frac{1}{4}$ ; depth  $3\frac{1}{5}$ ; D. I, VII-I, 39; A. II-I, 19; snout  $2\frac{2}{3}$  in head; eye 5; maxillary  $2\frac{1}{8}$ ; interorbital space  $2^9/_{10}$ ; fourth

erect dorsal spine  $4\frac{1}{2}$ ; second dorsal ray  $2\frac{1}{6}$ ; third anal ray 3; least depth of caudal peduncle  $5\frac{3}{4}$ ; upper caudal lobe  $1\frac{1}{4}$ ; pectoral  $1\frac{7}{8}$ ; ventral  $1\frac{1}{10}$ . Body ellipsoid or fusiform, well compressed. Head more or less conic, compressed, longer than deep, and upper profile descending in a gentle convex curve. Snout long, conic. Eye small, circular, a little anterior. Maxillary reaching a little beyond front rim of pupil, and its distal expansion about  $\frac{5}{6}$  of orbit. Jaws even. Mouth a little inclined. Teeth in broad bands, villiform, on both jaws, vomer, palatines and tongue. Width of supplemental maxillary about half of pupil. Nostrils together, small and a little nearer front of eye than tip of snout. Interorbital space highly convex. Gill-rakers  $6 + 16$ , longest  $\frac{2}{3}$  of orbit. Small scales on body and side of head. Lateral line a little convex at first, forming a slight keel on side of caudal peduncle. Spinous dorsal low, graduated from fourth or longest spine, and inserted a little behind pectoral. Rayed dorsal inserted nearer tip of snout than base of caudal, anteriorly elevated but without lobe. Anal similar, inserted about midway between origin of pectoral and base of caudal. First two anal spines small and inconspicuous. Caudal forked, lobes pointed. Pectoral short, broad, and a trifle more than half length of depressed ventral. Ventral about  $\frac{9}{11}$  to anal, with a deep basal groove, joining its fellow posteriorly, and extending back so both fins are depressible within. Color bluish above, whitish below. On side 6 broad vertical dusky bands extending on rayed dorsal and anal. A dark band from spinous dorsal to eye. Spinous dorsal and ventrals black, radii of latter whitish basally. Length  $7\frac{1}{4}$  inches. Sea Isle City.

Color of the above, when fresh in spirits, back and upper surface grayish or slaty-olivaceous, with greenish and bluish metallic reflections. Upper surface of head a little more olive than back, and jaws pale, lips translucent. Lower half of body whitish, washed with dull ochraceous tints from level with eye. On under surface of body whitish is most pronounced. Dorsals and caudal slaty, anal paler or a sort of translucent brownish. Pectoral translucent brownish, darker basally. Ventral with radii and bases whitish, and greater part of fin otherwise blackish.



A dusky-olive bar from eye back to occiput. From just before origin of dorsal to base of pectoral a broad band of dusky-olive, and becoming more or less ochraceous below as it continues a little below base of pectoral. Another similar band from base of spinous dorsal posteriorly and fading out below. Three more from soft dorsal, all wider than interspaces, and last two continued out to edge of anal. Another paler one across caudal peduncle, and another blotch on base of caudal. Blotches on upper fins black, on anal more or less brassy, and outer lobes of caudal blackish with extreme tips narrowly whitish. Edges of soft dorsal and anal narrowly whitish. Iris dull straw-color. Inside of mouth and gill-opening whitish.

My examples from the above locality obtained by Mr. Wm. J. Fox in August of 1905. A large food-fish reaching 3 feet in length and frequently occurring on our coast. The dark vertical bands disappear with age.

*Zonichthys zonatus* Abbott, Geol. N. J., 1868, p. 814.

*Seriola zonata* Bean, Bull. U. S. F. Com., VII, 1887, p. 139.—Moore, Bull. U. S. F. Com., XII, 1892, p. 361.—Smith, Bull. U. S. F. Com., XII, 1892, p. 373.

*Halatractus carolinensis* Abbott, Geol. N. J., 1868, p. 814.

***Seriola lalandi* Valenciennes.**

PLATE 26.

Jenny Lind.

Distinguished from the preceding by the fewer dorsal rays.

An important food-fish of 6 feet in length and 100 pounds in weight. According to Dr. Smith not abundant on the north shore.

*Seriola dumerili lalandi* Smith, Bull. U. S. F. Com., XII, 1892, p. 373.

Genus DECAPTERUS Bleeker.

The Mackerel Scads.

**Decapterus punctatus** (Agassiz).

Scad. Round Robin.

This fish may be easily distinguished from our other mackerel-like forms by the detached dorsal and anal finlet.

Only known from a few examples on our coast. Reaches a length of a foot.



Scad. *Decapterus punctatus* (Agassiz).

*Decapterus punctatus* Abbott, Geol. N. J., 1868, p. 813.—  
Moore, Bull. U. S. F. Com., XII, 1892, p. 361.

Genus CARANX Lacépède.

The Crevallés.

*Key to the species.*

- |   |        |
|---|--------|
| a. Breast naked, except a small rhombic area before ventrals. | HIPPOS |
| aa. Breast entirely scaly.                                    |        |
| b. Scutes about 40; body subfusiform.                         | CRYSOS |
| bb. Scutes about 30; body oblong-ovate.                       | LATUS  |

**Caranx hippos** (Linnæus).

PLATE 27.

Yellow Caranx. Yellow Mackerel. Southern Caranx. Crevallé.

Head  $3\frac{1}{5}$ ; depth  $2\frac{1}{7}$ ; D. I, VII–I, 21; A. II–I, 17; 31  
scutes in straight part of lateral line to base of caudal; mandible

2 in head; second erect dorsal spine  $2\frac{1}{3}$ ; first dorsal  $1\frac{7}{8}$ ; third anal spine  $4\frac{1}{8}$ ; first anal ray  $1\frac{9}{10}$ ; upper caudal lobe  $1\frac{1}{15}$ ; ventral 2; snout 4; eye  $3\frac{5}{6}$ ; maxillary  $2\frac{1}{6}$ ; interorbital space  $3\frac{4}{5}$ . Body rather oblong, deep, and greatest depth at origins of rayed dorsal and anal. Head deep, compressed and upper profile rather abruptly convex or strongly arched. Snout short, steep, compressed. Eye anterior, a little high, and with very broad adipose eyelids. Mouth large, low, oblique and mandible protruding. Maxillary reaching posterior margin of pupil, its distal expansion  $1\frac{3}{5}$  in orbit. Teeth in upper jaw in broad villiform band with an outer series of large wide-set conical ones. Mandibular teeth large, uniserial, and a distinct canine on each side of symphysis. Villiform teeth on vomer, palatines and tongue. Nostrils together, near front of eye medianly. Interorbital space with a median keel extending back of occiput, convex. Gill-rakers  $2 + 14$ , slender,  $1\frac{1}{2}$  in orbit. Arch of lateral line not greatly arched, a little greater than straight part. Dorsal spines graduated down from second erect one, which is longest, and origin of fin well behind that of pectoral. Rayed dorsal about midway between posterior margin of pupil and base of caudal, and anterior rays elevated to form a lobe. Anal similar, a little behind that of rayed dorsal. Caudal forked, lobes pointed, upper a little longer. Pectoral long and falcate, reaching beyond origin of anal. Ventral inserted opposite origin of pectoral, half way to origin of rayed anal. Color brownish above, sides and lower surface silvered. A blackish blotch about size of pupil on opercle. Length  $7\frac{3}{8}$  inches. Beesley's Point.

A well-known food-fish reaching a good size and several times taken on our coast. It may be identified from our other species chiefly by its naked breast, canines, steep convex upper profile, and color.

*Carangus hippos* Abbott, Geol. N. J., 1868, p. 813.

*Paratractus hippos* Abbott, l. c.

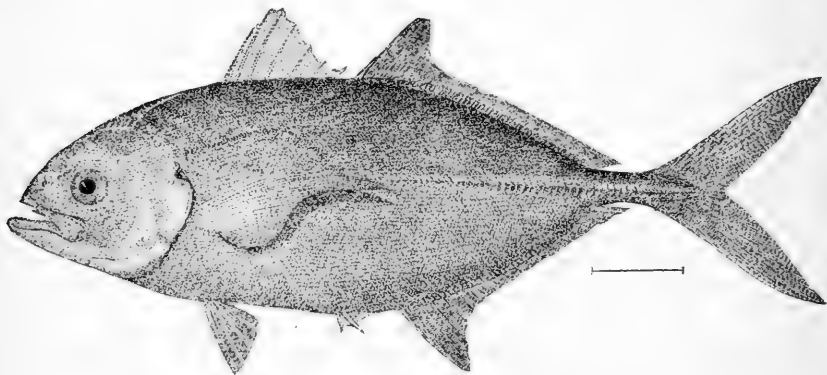
*Caranx hippos* Bean, Bull. U. S. F. Com., VII, 1887, p. 139.—Moore, Bull. U. S. F. Com., XII, 1892, p. 361.

*Caranx chrysos* Baird, 9th An. Rep. Smith's Inst., 1854, p. 336.

***Caranx crysos* (Mitchill).**

## Yellow Mackerel.

Head  $3\frac{5}{8}$ ; depth  $3\frac{1}{10}$ ; D. I, VIII-I, 23; A. II-I, 19; denticulate scutes in lateral line 42; mandible 2 in head; fourth erect dorsal spine  $2\frac{1}{3}$ ; first dorsal ray 2; first anal ray 2; upper caudal lobe  $1\frac{1}{15}$ ; pectoral 1; ventral  $2\frac{1}{10}$ . Body fusiform, profiles similar anterior and posterior. Head deep, compressed and upper profile forming an even curve. Snout rather sharp. Eye rather small, circular, and adipose eyelid rather narrow. Mandible slightly projecting. Mouth oblique, a little below axis of body.

Yellow Mackerel. *Caranx crysos* (Mitchill).

Teeth little, with an inner series in upper jaw, mandibular teeth uniserial and comparatively large. No canines. Fine teeth on vomer, palatines and tongue. Maxillary reaching about middle of orbit, its distal expansion  $1\frac{2}{3}$  in same. Nostrils about midway in length of snout. Interorbital space highly convex. Gill-rakers  $14 + 28$ , slender, longest less than longest filaments to  $1\frac{1}{3}$  in orbit. Curved part of lateral line  $1\frac{3}{4}$  in straight part and but slightly arched. Widest scute  $1\frac{1}{4}$  in orbit. Scales rather large. Spinous dorsal inserted about midway between posterior margin of orbit and origin of rayed dorsal, and fourth erect spine highest. Rayed dorsal inserted a little nearer base of caudal than tip of snout, and with anterior lobe little elevated. Rayed anal

similar, posterior or its insertion about midway between base of caudal and middle of eye. Second anal spine longer than first. Caudal forked, lobes slender and pointed. Pectoral nearly to origin of anal, falcate. Ventral inserted a trifle behind origin of pectoral, and half way to origin of anal. Color olivaceous above, golden-yellow below with silvery. A dusky slate blotch on opercle size of pupil. Fins pale, dorsals and caudal darker. Length  $8\frac{3}{4}$  inches. Sea Isle City.

Colors of the above when fresh. Back olivaceous-slaty, and line of demarcation between upper surface of eye and just above bony scutes of lateral line strongly contrasting lower surface, which is bright brassy-yellow and in some examples, with slightly clouded and nebulous effects. Dorsals and caudals olivaceous-gray, middle of each lobe of latter a little more greenish and posterior edge of each also a little pale. Spines of dorsal alternately burnished laterally with silvery. Membranes between each dorsal ray blotched with a little darker grayish than rest of fin so that base and margin of same are paler. Anterior edge of each dorsal ray also dusky or blackish. Anal pale or yellowish-white with a median pale grayish-yellow streak from base of anterior lobe well back on fin posteriorly. Anterior rays or lobe of anal yellowish with a somewhat greenish tint basally. Pectoral transparent pale yellowish, tinted with brownish above. Ventral pale yellowish, anterior margin whitish, and outer edge becoming transparent. Lower surface of head pale, and inside of gill-opening with pale brassy reflections. A nebulous blackish-slaty blotch on edge of opercle a little larger than pupil. Iris brownish. In some lights some of the examples show about nine indistinct broad transverse bands on back, the intervening space very narrow and slightly paler. Most all have the lower edge of caudal slightly pale or like the posterior margin. Jaws anteriorly both pale brownish. Maxillary pale brassy. Length of largest of 5 examples  $8\frac{7}{8}$  inches. Sea Isle City, N. J., Sept. 2nd, 1905, W. J. Fox.

Another example from the same locality taken Sept. 10th, 1905, by Mr. Fox is  $8\frac{1}{8}$  inches long. It is decidedly pale, the back more of a pale plumbeous or slaty-gray, and the sides and lower

surface whitish burnished with pale reflections of purplish, metallic greenish, or brassy. Head a trifle hyaline brownish above and lips translucent. Spinous dorsal dusky, spines burnished slightly with silvery. Rayed dorsal and caudal pale brownish, becoming dusky marginally, and tips of all three lobes blackish. Each caudal lobe submarginally with deep gamboge-golden tints. Pectoral, ventral and anal pale or dull brownish. A pale plumbeous-dusky blotch on opercle. Iris pale metallic brownish. A well-known and abundant food-fish on our coast about 1 foot in length.

*Carangus chrysos* Abbott, Geol. N. J., 1868, p. 813.

*Caranx chrysos* Moore, Bull. U. S. F. Com., XII., 1892, p. 361.

***Caranx latus* Agassiz.**

PLATE 28.

Jurel.

Head  $2\frac{4}{5}$ ; depth  $2\frac{1}{5}$ ; D. I, VII-I, 21; A. II-I, 18; snout  $3\frac{1}{2}$  in head measured from tip of upper jaw; eye  $3\frac{1}{8}$ ; maxillary  $2\frac{2}{5}$ ; interorbital space  $3\frac{2}{3}$ ; second erect dorsal spine  $2\frac{2}{5}$ ; first dorsal ray about  $2\frac{2}{5}$ ; first anal ray about  $2\frac{3}{7}$ ; lower caudal lobe  $1\frac{3}{4}$ ; pectoral  $1\frac{2}{3}$ ; ventral  $2\frac{1}{3}$ ; about 24 denticulate scutes in straight portion of lateral line to base of caudal. Body deep, compressed, deepest at origins of rayed dorsal and anal. Head rather deep, compressed, and upper profile obliquely convex. Snout short. Eye circular, anterior. Mouth oblique, mandible apparently projecting a little. Maxillary reaching front rim of pupil. Canine teeth in front of jaws but little enlarged. Interorbital space convex. Gill-rakers about 5 + 15, long, slender, about 2 in orbit. Breast scaly. Curved part of lateral line about  $1\frac{2}{5}$  in straight part. Spinous dorsal inserted behind origin of pectoral, and second erect spine longest, others graduated down. Rayed dorsal inserted nearly midway between posterior margin of pupil and base of caudal, anteriorly elevated from first ray which is longest. Rayed anal similar, inserted a little more posterior. Caudal forked, lobes pointed. Pectoral extending till nearly opposite base of third anal spine. Ventrals inserted a trifle be-

hind origin of pectoral, reaching first anal spine. Color silvery, back leaden-brownish. About 6 broad deeper-colored vertical bands on side. Hardly a trace of an opercular spot. Fins pale. Length  $1\frac{1}{2}$  inches. Squan River.

I have but the single young example, described above, from our coast, where it is rare.

### Genus ALECTIS Rafinesque.

#### The Thread Fishes.

##### *Alectis crinitus* (Mitchill).

##### Shoe Maker.

Distinguished by the high filamentous dorsal lobe, the first 5 or 6 rays being produced.

No examples before me from our coast, from which it has been rarely reported, and can only be considered a straggler from tropical America.

*Blepharichthys crinitus* Abbott, Geol. N. J., 1868, p. 813.

### Genus VOMER Cuvier.

#### The Plough Fishes.

##### *Vomer setapinnis* (Mitchill).

##### PLATE 29.

##### Moon Fish. Blunt Nosed Shiner.

Close to the next, but distinguished chiefly by the presence of scutes on the straight portion of the lateral line, though almost obsolete. The body is broadly ovate.

I have no examples. It occurs occasionally on our coast, however, generally distributed by the Gulf Stream.

*Vomer setipinnis* Abbott, Geol. N. J., 1868, p. 813.—Moore, Bull. U. S. F. Com., XII, 1892, p. 361.

Genus *SELENE* Lacépède.

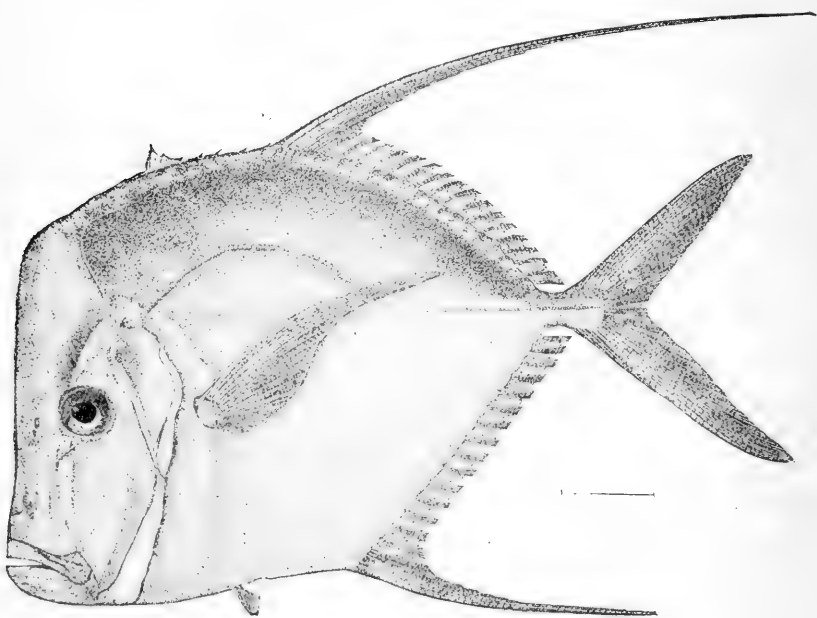
The Moon Fishes.

*Selene vomer* (Linnæus).

PLATES 30 AND 31.

Hair Finned Dory. Hair Finned Silver Fish. Dollar Fish.

Head  $2\frac{2}{7}$ ; depth  $1\frac{1}{3}$ ; D. III, VII-I, 21; A. II-I, 18; eye 3 in snout; maxillary  $1\frac{9}{10}$ ; mandible  $1\frac{1}{2}$ ; height of interorbital



Dollar Fish. *Selene vomer* (Linnæus). (Adult.)

space 3; width of interorbital space  $3\frac{1}{4}$ ; least depth of caudal peduncle  $4\frac{1}{10}$ ; pectoral 3 in space from tip of mandible to base of caudal; ventral  $2\frac{2}{5}$ ; lower caudal lobe  $2\frac{3}{4}$ . Body very closely compressed, much elevated, and profile very oblique, or nearly vertical with an abrupt occipital angle. Edges of body trenchant. Caudal peduncle thin, small, and compressed. Head short, very



deep and anterior profile nearly straight. Eye small, circular, about midway in depth of fish. Mouth rather small. Premaxillaries protractile, fitting into a notch between bases of maxillaries. A supplemental maxillary. Teeth in jaws minute, on tongue, vomer and palatines. Tongue narrow and free. Mandible deep, dentary bones thin, approximate. Nostrils together in inter-orbital region level with pupil. Gill-rakers  $8 + 26$ , slender, a little longer than filaments or about  $1\frac{2}{3}$  in orbit. Scales minute. Curved part of lateral line a trifle less than half length of straight part. Second erect dorsal spine elongate, others all short. Rayed dorsal a little posterior in length of head and trunk, and first ray long and filamentous. Rayed anal similar, though a little in advance of rayed dorsal. Caudal widely forked with slender lobes sharply pointed. Pectoral falcate, broad, a trifle more than half way to base of caudal. Ventral inserted a little before origin of pectoral, long and slender. Color silvery. Length 5 inches. Squan River.

My examples from the above locality, Anglesea and Beesley's Point. It has been observed occasionally along our shores, once at least at Cape May. Not used as food to my knowledge.

*Selene vomer* Moore, Bull. U. S. F. Com., XII, 1892, p. 361.—Smith, Bull. U. S. F. Com., XII, 1892, p. 373.

*Argyreiosus capillaris* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 337.—Abbott, Geol. N. J., 1868, p. 813.

*Selene gallus* Bean, Bull. U. S. F. Com., VII, 1887, p. 139.

#### Genus CHLOROSCOMBRUS Girard.

#### The Casabes.

#### *Chloroscombrus chrysurus* (Linnæus).

#### PLATE 32.

#### Yellow Tail.

Known from any other species in the family by the ventral profile, which is more convex than the dorsal.

I have no examples. Known from our coast by Dr. Abbott's record.

*Chloroscombrus chrysurus* Abbott, Geol. N. J., 1868, p. 813.

## Genus TRACHINOTUS Lacépède.

## The Pampanos.

*Key to the species.*

a. Lobes of vertical fins much elevated; dorsal rays 20.

FALCATUS

aa. Lobes of vertical fins short, not elevated; dorsal rays 25.

CAROLINUS

**Trachinotus falcatus** (Linnæus).

## PLATE 33.

## Spinous Dory. Round Pampano.

Head  $2\frac{5}{6}$ ; depth  $1\frac{4}{7}$ ; D. I, VI, I, 20, 1; A. II, I, 18, 1; snout 4 in head; eye 3; maxillary 3; interorbital space  $2\frac{3}{4}$ ; fourth dorsal spine  $3\frac{1}{2}$ ; second dorsal ray  $1\frac{3}{5}$ ; second anal spine 4; second anal ray  $1\frac{3}{5}$ ; lower caudal lobe 1; least depth of caudal peduncle  $3\frac{2}{5}$ ; pectoral  $1\frac{1}{2}$ ; ventral 2. Body deep, ovate, well compressed, and upper profile nearly straight from interorbital space to procumbent dorsal spine. Head deep, compressed, and blunt. Snout blunt, short, so that upper profile line of head would form an obtuse angle at front of interorbital space. Eye circular, well anterior. Mouth a little inclined, and upper jaw projecting a little beyond lower. Maxillary reaching in vertical a little beyond front rim of orbit, but not quite to that of pupil. Teeth minute, in bands in jaws. Interorbital space a little convex. Gill-rakers  $6 + 12$ , slender, longest about  $\frac{2}{3}$  diameter of pupil. Scales minute and smooth. Base of first erect dorsal spine about first quarter of pectoral, spines well freed, and fourth longest. Rayed dorsal inserted about midway between posterior margin of orbit and base of caudal, anteriorly elevated with a small lobe. Rayed anal inserted a little beyond origin of rayed dorsal, also with a slight anterior lobe. Second anal spine longest, joined to third by membrane. Caudal deeply forked, lobes pointed and slender, and lower longer. Pectoral short, reaching base of third anal spine. Ventral inserted a little behind origin of pectoral or a little before that of spinous dorsal. Color silvery-

gray, below whitish. Fins grayish. Dorsal lobe a little dusky. Length  $2\frac{1}{4}$  inches. Beesley's Point.

I have 3 examples collected many years ago by S. F. Baird at the above locality.

*Lichia spinosa* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 336.

*Trachynotus spinosus* Abbott, Geol. N. J., 1868, p. 814, from Baird.

*Trachynotus rhomboides* Bean, Bull. U. S. F. Com., VII, 1887, p. 339, Pl. 3, fig. 5.

***Trachinotus carolinus* (Linnæus).**

PLATE 34.

Common Pampano. Pampano. Butter Fish.

Head  $3\frac{1}{2}$ ; depth  $2\frac{1}{8}$ ; D. I, VI, I, 25, 1; A. II, I, 22, 1; snout 4 in head; eye  $4\frac{1}{3}$ ; maxillary 3; interorbital space 3; third dorsal ray  $1\frac{3}{5}$ ; third anal ray  $1\frac{2}{3}$ ; lower caudal lobe 1; least depth of caudal peduncle 3; pectoral  $1\frac{1}{3}$ ; ventral  $2\frac{1}{8}$ . Body oblong, comparatively robust in appearance, greatest thickness 3 in greatest depth. Head rather small, blunt. Snout blunt, its profile to interorbital space nearly vertical. Eye circular, well anterior. Mouth nearly horizontal. Maxillary reaching in vertical nearly to front rim of pupil, its expansion equal to diameter of pupil. Teeth in minute bands. Interorbital space convexly gibbous. Gill-rakers  $4 + 7$  short points. Scales minute and smooth. Base of first erect dorsal spine about first two-fifths in length of pectoral, spines well freed, and fifth erect longest. Rayed dorsal inserted about midway between posterior margin of eye and base of caudal, anteriorly elevated but without lobe. Rayed anal inserted a little posteriorly, or about midway between origin of pectoral and base of caudal, and fin similar to rayed dorsal. Caudal deeply forked, lobes pointed. Pectoral short, broad, two-thirds of space to origin of rayed anal. Ventral inserted a little behind pectoral's origin, a little over half-way to origin of anal. Color mostly silvery-slaty-gray above or on back. Pectoral and anal tinted with light orange-yellow. Length  $4\frac{3}{8}$  inches. Ocean City.

Color of the above in life a beautiful shining silvery-white, lower surface opaque, and back with a slightly leaden tint. Fins all more or less translucent in color, dorsal, caudal and pectoral grayish, anterior lobe of rayed dorsal tinted dusky, and lower distal end of lower caudal lobe tinted with dull orange. Anal orange-yellow on anterior rayed lobe, becoming whitish marginally at this portion of fin and basally posteriorly translucent. Extremity of lower caudal lobe also whitish. Spinous dorsal translucent grayish. Pectoral with lower half pale or whitish, and bases of upper rays gray. Spinous anal whitish, membranes but slightly tinted with pale yellow. Ventral with chalky-white radii, lower outer portion of fin pale orange and otherwise transparent. Iris beautiful silvery-gray, variable. After death the body assumes various beautiful shades of purplish, coppery and bronze, etc.

Abundant on sandy shores and in the surf at Ocean City and Stone Harbor. A valuable food-fish of firm, rich, delicate flesh. They are more tenacious of life than the silversides or hake.

*Lichia carolina* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 345.

*Trachynotus carolinus* Abbott, Geol. N. J., 1868, p. 813.—Bean, Bull. U. S. F. Com., VII, 1887, p. 140.

*Trachinotus carolinus* Moore, Bull. U. S. F. Com., XII, 1892, p. 361.—Smith, Bull. U. S. F. Com., XII, 1892, p. 373.

### Family POMATOMIDÆ.

#### The Blue Fishes.

Body oblong, compressed. Caudal peduncle rather stout. Head large, compressed. Mouth large, oblique. Premaxillaries protractile. Maxillary not slipping under preorbital, provided with large supplemental bone. Lower jaw projecting. Bands of villiform teeth on vomer and palatines, those on vomer forming triangular patch. Jaws each with a single series of very strong compressed unequal widely set teeth. Upper jaw with an inner series of small depressed teeth. Villiform teeth on base of tongue. Occipital keel strong. Free edge of preopercle pro-

duced and serrated. Opercle ending in a flat point. Gill-membranes free from isthmus, not united. Gills 4, a slit behind fourth. Gill-rakers slender, rather few. Pseudobranchiæ large. Branchiostegals 7. Air-vessel simple with thin walls. Pyloric cæca very numerous. Vertebrae  $10 + 14 = 24$ , as usual in *Carangidæ*. Body covered with rather small weakly ctenoid scales. Cheeks and opercles scaly. Lateral line present, unarmed. Dorsal fins 2, anterior of about VIII weak low spines, connected by membrane and depressible in groove. Second dorsal long, similar to elongate anal, and both fins densely scaly. Fin rays slender. Anal with II very small free anal spines sometimes hidden in skin. Caudal forked, lobes broad. Pectoral rather short. Ventrals I, 5, thoracic.

A single genus and species in all warm seas closely related to the *Carangidæ*.

### Genus POMATOMUS Lacépède.

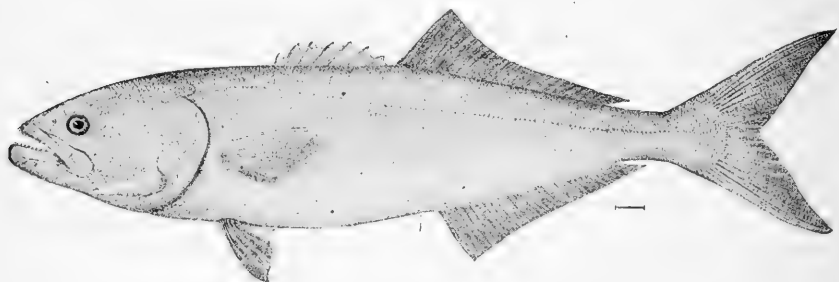
#### The Blue Fishes.

#### **Pomatomus saltatrix** (Linnæus).

Blue Fish. Mackerel. Snap Mackerel. Snapping Mackerel. Tailor. Snapper. Horse Mackerel. Skip Jack.

Head  $3\frac{1}{6}$ ; depth  $3\frac{2}{3}$ ; D. VII-I, 28; A. III, 27; scales 100 in lateral line to base of caudal, and about 6 more on latter; 6 scales between origin of spinous dorsal and lateral line; 17 scales in a vertical series between origin of anal and lateral line; mandible 2 in head; least depth of caudal peduncle  $3\frac{3}{5}$ ; pectoral  $1\frac{3}{4}$ ; ventral  $2\frac{2}{3}$ ; snout  $3\frac{2}{3}$  in head measured from tip of upper jaw; eye 6; maxillary  $2\frac{1}{4}$ ; interorbital space  $3\frac{4}{7}$ . Body deeply robust and moderately compressed. Belly compressed to a bluntish edge. Head deep, and upper profile more oblique. Snout a little long, compressed, and convex. Eye small, circular, in first two-fifths of length of head. Maxillary curved, reaching posterior margin of eye, and its distal expansion  $1\frac{1}{3}$  in orbit. Lips thick, teeth strong, and mandible well protruding. Nostrils together, high, and near upper front of

eye. Interorbital space convex. Gill-rakers  $3 + 11$ , slender, longest  $1\frac{3}{4}$  in orbit. Scales below lateral line in horizontal series, above in series parallel with its course. Rayed dorsal, anal, and base of caudal covered densely with small scales. Scales on cheek and opercle large. Lateral line not undulated, well on base of caudal. Spinous dorsal inserted nearer tip of snout than base of last dorsal ray, and third to fifth spines longest. Rayed dorsal elevated in front and inserted about midway between origin of pectoral and base of last dorsal ray. Anal similar, a little posterior or nearer base of last ray than origin of pectoral. Caudal emarginate. Pectoral three-fifths of space to anal. Ventral inserted a little behind pectoral, or well before spinous dorsal, and a little less than half-way to anal. Color greenish-blue above,



Blue Fish. *Pomatomus saltatrix* (Linnæus).

silvery below. A dusky blotch at base of pectoral. Length  $12\frac{3}{4}$  inches. Beesley's Point.

A large fish, reaching 3 feet in length, and extremely destructive to other fishes, especially the mackerel. As their flesh is of good flavor they are highly valued as food. Reported as not common at Cape May during 1903 and 1904. Schools are sometimes seen in the mouth of Delaware Bay, and though the big fish do not run in the young have been taken as far up the Delaware as the Rancocas Creek.

*Temnodon saltator* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 337.

*Pomatomus saltatrix* Abbott, Geol. N. J., 1868, p. 814.—Bean, Bull. U. S. F. Com., VII, 1887, p. 145.—Moore, Bull. U. S. F. Com., XII, 1892, p. 361.—Smith, Bull. U. S. F. Com., XII, 1892, p. 374.—Bean, Bull. Am. Mus. N. H., IX, 1897, p. 363.

## Family RACHYCENTRIDÆ.

## The Sergeant Fishes.

Body elongate, fusiform, subcylindrical. Peduncle moderate. Head rather broad, low, pike-like, bones above appearing through thin skin. Mouth rather wide, nearly horizontal. Maxillary reaching about to front of eye. Both jaws, vomer, palatines and tongue with bands of short sharp teeth. Lower jaw longer. Premaxillaries not protractile. Preopercle unarmed. Gill-rakers rather short, stout. Branchiostegals 7. No air-vessel. Pyloric cœca branched. Vertebrae  $12 + 13 = 25$ . Body covered with small smooth adherent scales. First dorsal of 8 low stout equal free spines, each depressible in a groove. Soft dorsal long, rather low, somewhat falcate, similar to a nearly opposite anal. Latter with II weak spines, I free from skin. Caudal forked and strong. No keel and no finlets. Pectoral moderate, placed low. Ventral I, 5, thoracic.

A single species on our coast. A large, strong, voracious shore-fish in all warm seas.

## Genus RACHYCENTRON Kaup.

## The Sergeant Fishes.

*Rachycentron canadus* (Linnæus).

## Crab Eater.

Head about  $3\frac{7}{8}$ ; depth 8; D. VIII, I, III, 27; A. IV, 20; mandible  $2\frac{1}{3}$  in head; first branched dorsal ray  $2\frac{2}{5}$ ; first branched anal ray  $2\frac{1}{3}$ ; pectoral  $1\frac{1}{3}$ ; ventral  $1\frac{1}{3}$ ; least depth of caudal peduncle  $3\frac{7}{8}$ ; snout  $2\frac{1}{2}$  in head measured from its own tip; eye  $5\frac{1}{4}$ ; maxillary  $2\frac{2}{7}$ . Body very long, slender, tail long and tapering but gradually. Head long, pointed, upper profile nearly straight. Snout long and slender. Eye small, rounded and about median in side of head. Mouth long, curved a little, and mandible projecting. Maxillary reaching front rim of pupil.

Spinous dorsal low, its origin nearer that of rayed fin than tip of snout, and spines equal. Insertion of rayed dorsal falling nearly midway between tip of snout and base of last dorsal ray, and radii graduated from first branched one. Anal inserted more posterior or nearly midway between posterior margin of opercle and base of last anal ray. Caudal large, expanded, and its margin rounded. Pectoral large, inserted a little before origin of spinous dorsal, and reaching a little less than  $\frac{2}{3}$  of space to anal. Ventral inserted opposite origin of pectoral, long, and inner ray about  $\frac{3}{5}$  length of fin. Color nearly black. A white stripe about as wide as pupil from upper angle of gill-opening to caudal. Another narrower one begins at lower extremity of pectoral base, curves very slightly upward as it fades out near



Crab Eater. *Rachycentron canadus* (Linnæus).

tail. Upper caudal lobe with a narrow whitish margin along its upper surface, relieved by a trace of orange-red at its base. Lower caudal lobe with a narrow orange-red margin. Pectoral, ventral and caudal black. Back fades to a dark green. Belly grayish-white. Iris golden-bronze. From young examples reaching 4 inches. Somer's Point. (From Bean.)

Known from our coast chiefly from Dr. Bean's record. It is a large fish reaching a length of 5 feet and is common in tropical seas.

*Elacate canada* Bean, Bull. U. S. F. Com., VII, 1887, p. 144, Pl. 2, fig. 13.

*Elacates niger* Abbott, Geol. N. J., 1868, p. 814.



## Family STROMATEIDÆ.

## The Fiatolas.

Body compressed and more or less elevated. Profile anteriorly blunt and rounded. Mouth small. Premaxillaries not protractile. Dentition feeble, none on vomer and palatines. Opercular bones smooth, not serrate. Preopercle entire and serrate. Gill-membranes free or not. Gills 4, a slit behind fourth. Gill-rakers rather long. Pseudobranchiæ present. Pharyngeals little developed. Usually no air-vessel. Pyloric cœca commonly numerous. Vertebrae 30 to 36. Œsophagus armed with numerous horny barbed or hooked teeth. Body covered with small or minute cycloid scales. Cheeks scaly. Lateral line well developed. Dorsal fin single, long, with spines few or weak, often obsolete. Anal fin long, similar to soft dorsal, usually with III small spines which are often depressible in a fold of skin. Caudal well forked. Ventral I, 5, thoracic in young, but reduced or altogether wanting in adult.

Fishes usually of small size, found in most warm seas, and many of them valued as food.

*Key to the genera.*

- a. Dorsal and anal well elevated anteriorly, lobes falcate; body suborbicular, no pores on side of back above lateral line. SESERINUS
- aa. Dorsal and anal moderately elevated anteriorly, anterior lobes scarcely falcate; body elliptical; a series of large wide-set pores above lateral line. PORONOTUS

## Genus SESERINUS Quoy and Gaimard.

## The Harvest Fishes.

**Seserinus paru** (Linnæus).

## PLATE 35.

## Rudder Fish.

Distinguished from the next chiefly by its suborbicular form and long falcate dorsal and anal.

It is known from our coast only from the record of Dr. Abbott. It is properly a native of southern waters and can only be said to be a straggler on our shores.

*Peprilus longipinnis* Abbott, Geol. N. J., 1868, p. 812.

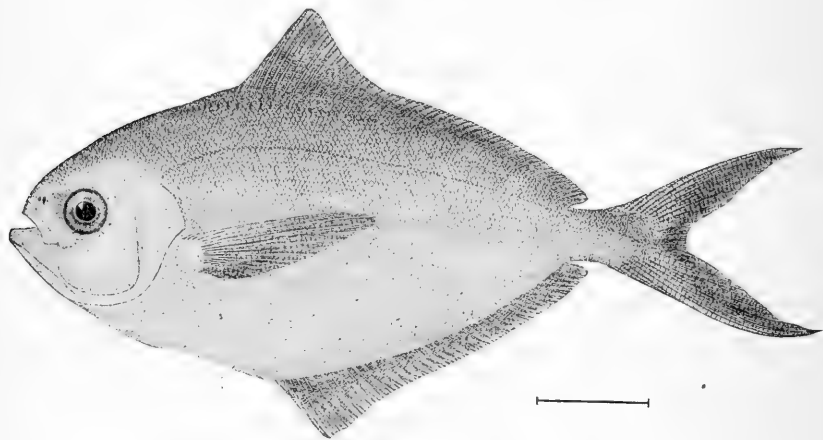
Genus PORONOTUS Gill.

The Butter Fishes.

*Poronotus triacanthus* (Peck).

Butter Fish. Harvest Fish. Dollar Fish.

Head  $3\frac{2}{5}$ ; depth  $2\frac{1}{7}$ ; D. III-I, v, 42, 1; A. II-I, v, 40, 1; snout  $3\frac{2}{3}$  in head; eye  $3\frac{1}{4}$ ; maxillary 3; interorbital space 3;



Butter Fish. *Poronotus triacanthus* (Peck).

first branched dorsal ray  $1\frac{4}{5}$ ; first branched anal ray 2; caudal 1; least depth of caudal peduncle  $3\frac{3}{4}$ ; pectoral 1. Body oval, much compressed, deep, and upper profile more evenly convex than lower. Caudal peduncle slender, compressed. Head deep, lower profile more inclined than upper, and upper convex. Snout very blunt, rounded in profile. Eye circular, a little anterior. Jaws short, about even. Mouth small, maxillary reaching about half way to orbit. Teeth a narrow cutting-edge around each jaw. Nostrils near together, in profile a little nearer tip of snout than base of caudal. Interorbital space convexly elevated. Gill-

rakers 7 + 13, lanceolate, rather stout, and longest about  $\frac{3}{7}$  of orbit. Scales minute. Lateral line high and concurrent with dorsal profile. A series of conspicuous pores above lateral line near base of dorsal. Dorsal begins about opposite first fourth of pectoral, and first branched rays highest. Anal similar, origin of rayed fin beginning about opposite last  $\frac{2}{3}$  of pectoral. Caudal strongly forked, lobes slender and pointed. Pectoral long, lanceolate. Color slaty-blue above, below silvery. Length  $4\frac{7}{8}$  inches. Sea Isle City.

It also occurs at Cape May, Stone Harbor, Beesley's Point and Atlantic City. An excellent pan-fish of fine flavor reaching a length of 10 inches. Very abundant during the late summer and early fall.

*Peprilus triacanthus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 338.

*Poronotus triacanthus* Abbott, Geol. N. J., 1868, p. 812.—Bean, Bull. U. S. F. Com., VII, 1887, p. 140.

*Stromateus triacanthus* Moore, Bull. U. S. F. Com., XII, 1892, p. 361.—Smith, Bull. U. S. F. Com., XII, 1892, p. 374.

## Family CENTROLOPHIDÆ.

### The Rudder Fishes.

Body oblong, or elongate, compressed. Mouth moderate, with small teeth. Premaxillaries protractile. Bones of head sometimes serrulate. Skeleton moderately firm. Œsophagus with tooth-like processes as in *Stromateidæ*. Vertebrae in normal number, 10 + 14 or 15 = 24 or 25. Body covered with moderate cycloid adherent scales. Lateral line present, straightish. Dorsal fin long, 3 to 10 of anterior rays simple, more or less spine-like. Anal similar, shorter. Caudal lunate. Ventral I, 5, well developed, thoracic.

Fishes of open seas, inhabiting moderate depths.

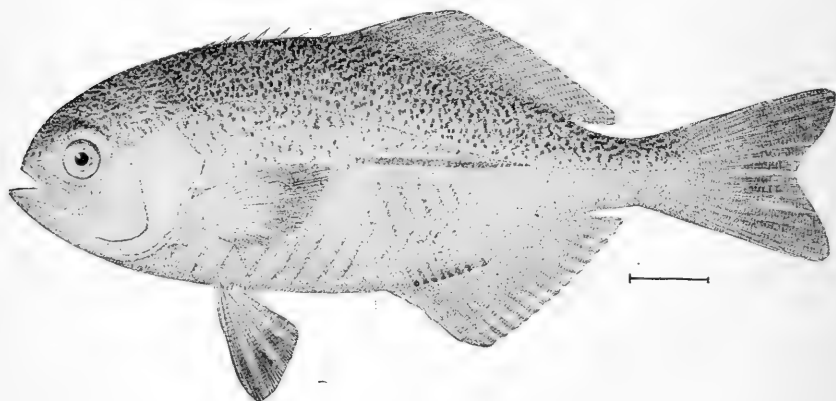
Genus *PALINURICHTHYS* Bleeker.

The Black Rudder Fishes.

*Palinurichthys perciformis* (Mitchill).

Black Rudder Fish.

Known principally by the short stout subequal dorsal spines, shorter than soft rays, scarcely connected by membrane. Preopercle, interopercle and subopercle finely serrate.



Black Rudder Fish. *Palinurichthys perciformis* (Mitchill).

Known only from Dr. Smith's record. I have, however, reports of several fishermen that a fish which may possibly be this species has been seen off Stone Harbor.

*Leirus perciformis* Smith, Bull. U. S. F. Com., XII, 1892, p. 374.

Family **CORYPHÆNIDÆ.**

The Dolphins.

Body elongate, compressed. Cleft of mouth wide, oblique, mandible projecting. Cardiform teeth in jaws and on vomer and palatines. Patch of villiform teeth on tongue. Opercular bones entire. Gill-membranes free from isthmus. No pseudo-branchiæ. Branchiostegals 7. No air-vessel. Pyloric appen-

dages very numerous. Vertebrae about 30. Skull with a crest which is more elevated in adult than in young. No teeth on œsophagus. Body covered with small cycloid scales. Lateral line present. A single many-rayed dorsal fin, not greatly elevated, extending from nape nearly to caudal fin. Anal similar but shorter, both without distinct spines. Caudal widely forked. Pectoral fins very short and small. Ventrals well developed, I, 5, thoracic, and partly received into a groove in abdomen.

Large fishes inhabiting high seas in warm regions, noted for their brilliant and changeable colors.

Genus CORYPHÆNA Linnæus.

The Dolphins.

*Coryphæna hippurus* Linnæus.

Dolphin.

This species has from 55 to 65 dorsal rays, and 26 to 30 anal rays.



Dolphin. *Coryphæna hippurus* Linnæus. (Upper figure male, lower female.)

I have no examples of this fish, except one in the collection of the Academy of Natural Sciences of Philadelphia, which was procured in the Philadelphia market. It may have been taken somewhere on the New Jersey coast, though there is no evidence to prove this.

*Coryphæna hippurus* Bean, Bull. Am. Mus. N. H., IX, 1897, p. 363.

*Coryphæna lescurii* Abbott, Geol. N. J., 1868, p. 811.

### Family APHREDODERIDÆ<sup>1</sup>.

#### The Pirate Perches.

Body oblong, elevated at base of dorsal, and compressed behind. Caudal peduncle deep. Head thick, depressed and profile concave. Mouth moderate, somewhat oblique, lower jaw projecting, and maxillary reaching anterior border of eye. Teeth in villiform bands on jaws, vomer, palatines and pterygoids. Premaxillaries not protractile, and maxillaries small, without evident supplemental bone. Preopercle and preorbital with free edges sharply serrate. Opercle with spine. Bones of skull somewhat cavernous. Gill-membranes slightly joined to isthmus anteriorly. Gills 4, a small slit behind fourth. Gill-rakers tubercle-like, dentate. Pseudobranchiæ obsolete. Lower pharyngeals narrow, separate, with villiform teeth. Branchiostegals obsolete. Sides of head scaly. Scales moderate, strongly ctenoid, adherent. Lateral line imperfect or wanting. Dorsal fin single, median, high, spines III or IV and rapidly graduated, first very short. Anal small, with III slender spines. Ventrals thoracic, without distinct spine, and rays usual 7. Caudal rounded. Vent always anterior, its position varying with age from just behind ventrals in young to below preopercle in adult. Air-vessel simple, large, adherent to walls of abdomen. Vertebrae 14 + 15. Pyloric cæca about 12.

A single genus with one species confined to the United States.

<sup>1</sup>*Percopsis guttatus* Agassiz has been credited to the Delaware River by writers with reference to its capture by Dr. Charles C. Abbott. However, Dr. Abbott tells me that he has never taken this fish in the Delaware, and also that he has never seen a specimen from any part of the same river system. The confusion he attributes to the remark which he made that Baird had reported it from Easton, Pa.

## Genus APHREDODERUS Le Sueur.

## The Pirate Perches.

*Aphredoderus sayanus* (Gilliams).

## PLATE 36.

## Pirate Perch. Pirate. Mud Perch.

Head  $2\frac{7}{8}$ ; depth 3; D. IV, 12; A. III, 7; scales 44 in lateral line to base of caudal and 3 more on latter; 9 scales between origin of spinous dorsal and lateral line; 11 scales in a vertical series between origin of spinous anal and lateral line; mandible  $2\frac{1}{10}$  in head; third dorsal spine  $2\frac{4}{7}$ ; second dorsal ray  $1\frac{3}{4}$ ; third anal spine 3; second anal ray  $1\frac{9}{10}$ ; caudal  $1\frac{2}{7}$ ; pectoral  $1\frac{2}{3}$ ; ventral  $1\frac{2}{3}$ ; snout  $3\frac{1}{3}$  in head, measured from tip of upper jaw; eye  $4\frac{3}{5}$ ; maxillary  $2\frac{1}{2}$ ; interorbital space  $3\frac{4}{7}$ . Body rather deep, upper profile a little more convex than lower. Caudal peduncle compressed. Head large, upper profile a little concave. Snout broad, rather convex. Eye circular, small, anterior. Mouth with mandible well protruding. Teeth small. Maxillary reaching front rim of orbit, and its distal expansion equals diameter of pupil. Interorbital space broad, but slightly convex. Gill-rakers 3 + 10 asperous tubercles. Scales becoming a little smaller on predorsal region, caudal peduncle and breast. Spinous dorsal inserted nearer tip of mandible than base of caudal. Rayed dorsal inserted about midway in that distance and higher anteriorly. Anal begins about midway between origin of pectoral and base of caudal, spines graduated to third which is longest, and rayed fin rounded. Caudal rather large. Pectoral about  $\frac{5}{8}$  of space to anal. Ventral inserted close behind origin of pectoral, and reaching  $\frac{2}{3}$  of space to anal. Color brownish. Base of caudal with 2 transverse dusky bars with a pale one between. Length  $3\frac{1}{2}$  inches. Crosswicks Creek near Trenton.

Color in life dusky-brown, blacker on head and caudal and other fins, except ventral. Iris brown. A black band from eye down across cheek. A sky-blue reflection just below lower margin of opercle on shoulder-girdle. Opercle and cheek with deep

purplish and green reflections. A blackish transverse vertical band on caudal peduncle at base of caudal. Peritoneum showing through on cœlome. Lower surface of head pale translucent brown sprinkled with dusky dots. Inside of gill-opening with greenish and dusky. A blackish blotch from eye posteriorly along and above opercle. Anal tube on belly coppery. Lips dusky. Margin of caudal posteriorly and above narrowly whitish. Length 2 inches. These notes from an example found with *Umbra* and *Esox* in the sphagnum of the Wading River, at Speedwell, April 30th, 1904.

Very abundant in tide-water in the lower Delaware. They are mostly found concealed in thick vegetation during the day, though I have frequently taken them with *Enneacanthus*, *Apeltes*, *Fundulus*, *Erimyzon* and other of our common tide-water fishes. Many examples from the Egg Harbor River, Batsto River and Cedar Swamp Creek.

*Aphredoderus sayanus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 326.—Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 95.—Abbott, Rep. U. S. F. Com., 1875-76, p. 840.—Bean, Bull. U. S. F. Com., VII, 1887, p. 145.—Bean, Bull. Am. Mus. N. H., IX, 1897, p. 357.

*Aphredoderus sayanus* Abbott, Geol. N. J., 1868, p. 807.—Abbott, Am. Nat., IV, 1870, pp. 101, 105, 107.

*Aphododerus sayanus* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 101.—Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132.—Abbott, Nat. Rambles, 1885, p. 478.—Cope, Am. Nat., XXX, 1896, p. 943.

### Family CENTRARCHIDÆ.

#### The Sun Fishes.

Body more or less shortened and compressed. Regions above and below axis of body nearly equally developed, and corresponding to each other. Head compressed. Mouth terminal, large or small. Teeth in villiform bands, outer slightly enlarged, without canines. Teeth present on premaxillaries, lower jaw, vomer and usually on palatines, also sometimes on tongue, pterygoids



and hyoid. Premaxillaries protractile. Maxillary with a supplemental bone in large-mouthed forms, sometimes minute or obsolete in others. Preopercle entire or somewhat serrate. Opercle ending in 2 flat points or prolonged in a black flap at angles. Preorbital short and deep. First suborbital narrow, maxillary not slipping under edge. Nostrils 2 on each side. Gill-membranes separate, free from isthmus. Gills 4, slit behind fourth. Gill-rakers variously formed, armed with small teeth. Pseudo-branchiæ small, imperfect, almost glandular, nearly or quite covered by skin. Branchiostegals 6, rarely 7. Lower pharyngeal bones separate, teeth conic or sometimes paved. Intestinal canal short. Pyloric cæca 5 to 10. Vertebrae 28 to 35 (13 to 18 + 15 to 17). Entopterygiod present. Precaudal or abdominal vertebrae with transverse processes from third or fourth to last. Ribs all but last 2 to 4 sessile, inserted on centrum behind transverse processes. Frontals with pair of large muciferous channels which converge posteriorly, or are confluent with a transverse channel connecting their posterior openings close together on median line in front of supraoccipital crest. Cheeks and opercles scaly. Body fully scaled, scales usually not strongly ctenoid, rarely cycloid. Lateral line present, usually complete. Dorsal fins confluent, spines VI to XIII in number, usually X, depressible in a shallow groove. Anal spines III to IX. Coloration usually brilliant, chiefly greenish. Sexes similar, changes with age often great.

Fresh-water fishes of North America, forming one of the most characteristic features of our fish-fauna. Most of the species build nests which they defend with much courage. All are carnivorous, voracious and gamy, and valued as food, their importance being in direct proportion to the size they attain.

### *Key to the genera.*

- a. Tongue and pterygoids with teeth; mouth large, maxillary reaching past middle of eye; scales cycloid; caudal convex. ACANTHARCHUS
- aa. Tongue and pterygoids toothless; mouth small, maxillary barely reaching past middle of eye.
  - b. Caudal convex; opercle emarginate, without flap.
    - c. Dorsal continuous, normally with IX spines; anal normally with III spines. ENNEACANTHUS
    - cc. Dorsal angulated, some of median spines elevated, X; anal spines III. MESOGONISTIUS

*bb.* Caudal margin concave; opercle prolonged behind in a convex process or flap, which is always black; dorsal spines X; anal III.

*d.* Lower pharyngeals narrow; teeth usually sharp, not conical.

LEPOMIS

*dd.* Lower pharyngeals broad and convex, especially in adult; teeth more or less blunt and paved.

EUPOMOTIS

## Genus ACANTHARCHUS Gill.

### The Mud Sun Fishes.

#### *Acantharchus pomotis* (Baird).

PLATE 37.

#### Mud Sun Fish. Bass Sun Fish.

Head  $2\frac{2}{3}$ ; depth  $2\frac{2}{5}$ ; D. XI, 11, 1; A. V. 11, 1; scales 40 in lateral line to base of caudal; 6 scales obliquely back from origin of spinous dorsal to lateral line; 12 scales in a vertical series between origin of spinous anal and lateral line; mandible  $2\frac{1}{10}$  in head, measured from its own tip; fourth dorsal spine  $3\frac{2}{3}$ ; sixth dorsal ray  $1\frac{2}{3}$ ; fourth anal spine 4; sixth anal ray about 2; caudal  $1\frac{1}{10}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{4}$ ; ventral spine 3; snout  $5\frac{1}{2}$  in head, measured from tip of upper jaw; eye  $4\frac{1}{3}$ ; maxillary  $2\frac{1}{6}$ ; least depth of caudal peduncle 2. Body robust, moderately compressed, and not much elevated. Head large. Snout short, rather broad and convex. Eye circular, moderate, and about first third in length of head. Mouth wide, not large, and gape short. Mandible protruding. Maxillary oblique, about reaching posterior margin of orbit, and its distal expansion  $1\frac{2}{3}$  in orbit. Teeth rather large, conic, and in bands in jaws. Vomerine, palatine, pterygoid and lingual teeth small, latter in a single patch. Interorbital space flattened and forming a depression in upper profile. Nostrils close in front of upper orbital rim. Gill-rakers 5, 2 on lower limb of first arch, lanceolate, and longest a trifle shorter than pupil. Scales large, cycloid, reduced along bases of fins and on predorsal region. Lateral line of rather large simple tubes, rather concurrent with dorsal profile. Small scales on bases of rayed dorsal, anal and caudal. Spinous

dorsal low, its origin close behind that of pectoral, margin deeply notched, and last spine about equal to snout and half of orbit. Rayed dorsal inserted midway between middle of pectoral and base of caudal. Spinous anal inserted midway between tip of ventral spine and base of caudal. Caudal rounded. Pectoral reaching a little beyond origin of spinous anal. Ventral inserted below origin of pectoral, reaching as far back as pectoral's tip. Color deep olivaceous, about five nebulous longitudinal lateral bands. Cheeks with dark bands nearly parallel, lowest across maxillary around front of mandible. Opercle posteriorly with a blackish blotch. Fins dusky. Length  $7\frac{5}{8}$  inches. Crosswicks Creek near Trenton.

This species is very abundant in the coastwise streams and I have examined a large series from the Great Egg Harbor River, pools at the head of same near Winslow and Cedar Swamp Creek. They show the following: Head  $2\frac{1}{8}$  to  $2\frac{3}{4}$ ; depth  $2\frac{1}{5}$  to  $2\frac{3}{4}$ ; D. XI, seldom XII, 10, 1, usually 11, 1, rarely 12, 1; A. seldom IV, usually V, rarely VI, seldom 9, 1, usually 10, 1, or 11, 1, and rarely 12, 1; scales 32 to 42, mostly 38 or 39, in lateral line to base of caudal; seldom 5, usually 6, scales between origin of spinous dorsal and lateral line; 11 to 14 scales between lateral line and origin of anal, mostly 12; maxillary  $2\frac{1}{10}$  to  $2\frac{3}{5}$  in head, from tip of upper jaw; eye  $3\frac{1}{6}$  to  $5\frac{1}{3}$ , large in young; total length of fishes  $2\frac{1}{16}$  to  $7\frac{1}{2}$  inches.

In the Delaware Valley it is only known from the New Jersey tributaries. I have taken examples at Trenton, and have others from Brown Mills, in Burlington County, from a small affluent of the Rancocas Creek. It associates with other fishes, those which I secured were taken with *Enneacanthus obsesus*, *Erimyzon sucetta oblongus*, *Brama crysoleucas*, *Lepomis auritus*, *Bolcichthys fusiformis*, *Fundulus diaphanus*, *Notropis*, etc., in small weedy ponds. I have never seen it in clear water without some cover in the form of vegetation. Although of rather subdued coloration it is a beautiful fish in life. It reaches a length of  $7\frac{3}{4}$  inches. I am not informed concerning its qualifications as a food-fish, though it has been reported to be of little value. Alcoholic examples show nothing beyond the usual individual variation

when compared with examples from coastwise streams, such as the Egg Harbor River and Cedar Swamp Creek.

The Delaware River examples show the following: Head  $2\frac{2}{5}$  to  $2\frac{3}{4}$ ; depth  $2\frac{1}{3}$  to  $2\frac{1}{2}$ ; D. XI, 11 or 12; A. V or VI, 9 to 11; scales 35 to 39 in lateral line to base of caudal; scales 6 between origin of spinous dorsal and lateral line, and 12 between latter and origin of spinous anal; maxillary  $2\frac{1}{10}$  to  $2\frac{1}{3}$  in head, from tip of upper jaw; eye 4 to  $4\frac{1}{2}$ ; total length of fishes  $4\frac{1}{8}$  to  $7\frac{3}{4}$  inches.

*Centrarchus pomotis* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 325.

*Ambloplites pomotis* Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 95.—Abbott, Geol. N. J., 1868, p. 807.—Abbott, Am. Nat., IV, 1870, p. 102.—Abbott, Rep. U. S. F. Com., 1875-76, p. 841.—Boulenger, Cat. Fish. Brit. Mus., Ed. II, I, 1895, p. 11.

*Acantharchus pomotis* Abbott, Am. Nat., IV, 1870, p. 386.—Abbott, Rep. U. S. F. Com., 1875-76, p. 837.—Jordan, An. N. Y. Acad. Sci., I, 1879, p. 100.—Abbott, Nat. Rambles, 1885, p. 477.—Bean, Bull. U. S. F. Com., VII, 1887, p. 143.

*Acantharcus pomotis* Cope, Am. Nat., XXX, 1896, p. 943.—E. Smith, Tr. Linn. Soc. N. Y., No. IX, 1897, p. 42.

## Genus ENNEACANTHUS Gill.

### The Spotted Sun Fishes.

#### Key to the species.

- a. Black opercular blotch smaller than pupil; males in spring with bright blue spots, transverse dark bands faint or wanting. GLORIOSUS
- aa. Black opercular blotch as large or larger than pupil; transverse dark bands rather distinct. OBESUS

#### **Enneacanthus gloriosus** (Holbrook).

#### PLATE 38.

Spotted Finned Sun Fish. Blue Spotted Sun Fish. Spotted Sun Fish.

Head  $2\frac{2}{3}$ ; depth  $1\frac{7}{8}$ ; D. X, 11; A. III, 11, 1; scales 33 in lateral line to base of caudal; 5 scales obliquely back from origin of

spinous dorsal to lateral line; 10 scales in a vertical series between origin of anal and lateral line; mandible  $2\frac{1}{2}$  in head; fourth dorsal spine  $2\frac{7}{8}$ ; seventh dorsal ray  $1\frac{2}{7}$ ; third anal spine  $2\frac{3}{5}$ ; seventh anal ray  $1\frac{1}{3}$ ; caudal  $1\frac{1}{6}$ ; least depth of caudal peduncle 2; pectoral  $1\frac{1}{4}$ ; ventral  $1\frac{1}{4}$ ; snout  $4\frac{1}{2}$  in head measured from tip of upper jaw; eye  $3\frac{1}{2}$ ; maxillary 3; interorbital space 4. Body deeply ovate, compressed. Head moderate, compressed. Snout short convex. Eye circular, about first third in head. Maxillary oblique, about reaching front of pupil, and its greatest expansion about equals same. Mouth moderate, very oblique. Teeth minute, in bands in jaws, on vomer and palatines. No teeth on tongue. Mandible protruding but little. Interorbital space slightly convex. Nostrils separated, near upper front rim of orbit. Gill-rakers  $1 + 9$  II, robust, lanceolate, longest about half of pupil. Scales rather large, smaller along and on bases of rayed vertical fins. Scales in 6 rows on cheek. Lateral line complete. Spinous dorsal inserted opposite origin of pectoral, margin notched, and spines graduated from fourth, fifth and sixth, which are subequally longest. Rayed anal inserted about midway between middle of orbit and base of caudal, high, and when depressed reaching beyond base of caudal. Spinous anal inserted about midway between posterior margin of orbit and base of caudal, graduated to third spine which is longest. Rayed anal high, and reaching back well beyond base of caudal. Caudal rounded. Pectoral reaching margin of rayed anal. Ventral inserted just behind origin of pectoral, reaching origin of rayed anal, and spine reaching base of third anal spine. Color dull olive, with indistinct traces of vertical dark bars. Ear flap small, black margined with blue and a pearly spot in front. A dark bar about as wide as pupil down below eye. Body everywhere with round bright azure spots in irregular series, most distinct on cheek, opercle and lower side. Length  $3\frac{7}{16}$  inches. Crosswicks Creek, near Trenton.

I have examined a large series of examples taken in the Delaware basin at Trenton and Brown Mills. It is a beautiful little fish, preferring rather still clear waters, or only those with a gentle current. I have found them mostly among the weeds or grasses along borders of ponds, where they are at times abundant.

They associate usually with others of our well-known fishes, such as *Notropis chalybaeus*, *Brama crysolencas*, *Erimyzon sucetta oblongus*, *Lepomis auritus* and *Eupomotis gibbosus*.

They are frequently taken in the main channel of the Delaware. In small weedy ditches with little water they frequently associate with *Umbra pygmaea*. In size they seldom exceed 4 inches. When seen in life a beautiful fish, the spots on the body of a most brilliant sky-blue in some examples and of a dull greenish-blue in others. The female is duller and with smaller fins. The young are with dark vertical bands which persist more or less indistinctly sometimes in adult examples. This species may, however, be easily recognized by the small black spot on the opercle, which is always much smaller than the pupil of the eye. *Enneacanthus obesus* is a closely-related species, but may readily be distinguished by the large dark opercular spot, which is larger than the pupil of the eye, and the distinct dark transverse bands. I also have a large series of New Jersey examples from White Pond and the Batsto River, where it was found abundantly by Cope.

*Bryttus punctatus* Abbott, Am. Nat., IV, 1870, pp. 101, 102, lapsus for *guttatus*.

*Enneacanthus guttatus* Abbott, Rep. U. S. F. Com., 1875-76, p. 837.

*Enneacanthus margarotis* Gill and Jordan, in Jordan, Bull. U. S. Nat. Mus., X, 1877, p. 28.—Jordan, An. N. Y. Acad. Sci., I, 1879, p. 98.

*Enneacanthus simulans* Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132.—Abbott, Nat. Rambles, 1885, p. 477.

*Apomotis obesus* Boulenger, Cat. Fish. Brit. Mus., Ed. II, I, 1895, p. 19, in part.

***Enneacanthus obesus* (Girard).**

Sun Fish. Spotted Fin Sun Fish. Spotted Sun Fish. Rock Sun Fish.

Head  $2\frac{1}{2}$ ; depth  $2\frac{1}{10}$ ; D. IX, 11, 1; A. III, 11; scales 30 in lateral line to base of caudal; 6 scales between origin of spinous dorsal and lateral line; 11 scales between origin of spinous anal

and lateral line in a vertical series; mandible  $2\frac{1}{3}$  in head; ninth dorsal spine  $2\frac{1}{3}$ ; seventh dorsal ray  $1\frac{1}{3}$ ; third anal spine  $2\frac{2}{3}$ ; fourth anal ray  $1\frac{3}{10}$ ; least depth of caudal peduncle  $2\frac{2}{5}$ ; caudal  $1\frac{1}{6}$ ; pectoral  $1\frac{1}{4}$ ; ventral  $1\frac{1}{3}$ ; ventral spine  $2\frac{4}{5}$ ; snout 5 in head, measured from tip of upper jaw; eye  $3\frac{3}{4}$ ; maxillary  $2\frac{4}{5}$ ; interorbital space  $3\frac{3}{4}$ . Body oblong, ovate-elliptical, well compressed. Head large. Snout rather short, convex. Eye large, anterior and circular. Mouth well inclined, with protruding mandible. Teeth in bands in jaws. Maxillary reaching front rim of pupil, and its distal expansion equals same. Interorbital space slightly convex and forming a slight depression in upper profile of head. Gill-rakers II  $2 + 12$ , lanceolate, longest about 3 in orbit. Scales large, extending on rayed dorsal, anal and caudal basally where they are smaller. Scales in 4 series on cheek. Tubes of lateral line simple, concurrent with dorsal profile. Spinous dorsal inserted just behind origin of pectoral, margin a little notched, and spines graduated up to fourth, after which they are more or less subequal. Rayed dorsal inserted about midway between posterior margin of orbit and base of caudal, and fin reaching well beyond base of caudal. Rayed anal similar. Spinous anal inserted midway between middle of orbit and base of caudal, graduated to third spine, which is longest. Caudal rounded. Pectoral reaching origin of rayed anal. Ventral inserted about opposite origin of pectoral and reaching base of third anal ray. Color dull olive-brown, with 8 well-defined vertical dark cross-bands. Body and fins spotted with golden. A dark bar extending below eye. Length  $3\frac{1}{2}$  inches. Pool at head of Egg Harbor River.

Color in life olivaceous, side and lower surface pale. About eight transverse bands on body a little darker than body-color, and fading or becoming paler below. Lower surface and side of body with purplish reflections. Same on side of head, where they are variegated with ruddy or reddish and golden shades. Peritoneum showing through translucent abdomen livid white, with greenish tints above. Lips olivaceous. A dusky bar from eye down over cheek, and another over opercle above to dark opercular blotch. Fins dull brownish, marginally darker, and with several dark cross-lines on each one. Pectoral and ventral

pale olivaceous-brown, latter darker marginally. Lower surface of body with pale light mottlings. Iris umber. Length 1 inch. These fish were found in the sphagnum of the Wading River, near Speedwell.

Though they appeared rather small in the Wading River, those taken in small bodies of water and in the ditches were sometimes quite large. They generally struggled a little when first captured, after which they soon died. It is beautiful in its more or less sombre colors, and is a very characteristic inhabitant of the cedar-stained streams. Many examples were examined from Cedar Swamp Creek, pools at the head of the Egg Harbor River, and pool Tolsoms. I found them abundant in the sphagnum of the Great Egg Harbor River above May's Landing. They were not found in clear or open places, but preferred the concealment of the sphagnum shores. It was only by grouping about in such places with a dip-net that they were secured. They do not swim boldly about the open places or small channels, like the *Mesogonistius*, but seem altogether more retiring. Their coloration is admirably adapted to further their protection. When captured in a dip-net they frequently struggle a short interval very rapidly, especially flapping the tail from side to side, then remaining perfectly quiet, only to repeat this performance again and soon expire.

Dr. Abbott was formerly under the impression that this species was the male *Enneacanthus gloriosus*. All the numerous examples which he dissected were found to contain milt, while all of the examples of *gloriosus* contained ova. Upon recent investigation I find that both the *obesus* and *gloriosus* forms are certainly two distinct species, as both milt and roe have been found in examples of each. Dr. Abbott also tells me that he has found spotted males very abundant at Trenton, but only during the fore part of the year, while the females may be obtained any time. The description by Dr. Bean, based on an example collected at Beesley's Point, does not refer to the type of this species. The type will be found to have been taken in Massachusetts and described, apparently previous to Baird's account, by Girard.

*Pomotis obesus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 324.

*Bryttis obesus* Abbott, Geol. N. J., 1868, p. 807.



*Enneacanthus obesus* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 98.—Abbott, Nat. Rambles, 1885, p. 477.—Bean, Bull. U. S. F. Com., V, 1887, p. 143, from Baird.—E. Smith, Tr. Linn. Soc. N. Y., No. 9, 1897, p. 42.

*Apomotis obesus* Cope, Am. Nat., XXX, 1896, p. 943.

### Genus MESOGONISTIUS Gill.

#### The Banded Sun Fishes.

#### *Mesogonistius chætodon* (Baird).

#### PLATE 39.

#### Banded Sun Fish. *Chætodon*.

Head  $2\frac{7}{8}$ ; depth  $1\frac{3}{4}$ ; D. X, 11; A. II, 12; P. II, 8; V. I, 5; scales about 29 (squamation injured) in lateral line to base of caudal; 5? scales between origin of spinous dorsal and lateral line, and 10 between latter and origin of spinous anal; width of head  $1\frac{7}{8}$  in its length; depth of head over anterior margin of eye  $1\frac{2}{3}$ ; snout 4; eye 3; maxillary 3; interorbital space  $3\frac{1}{4}$ ; fourth dorsal spine  $1\frac{4}{7}$ ; second dorsal ray  $1\frac{1}{3}$ ; third anal spine  $1\frac{3}{5}$ ; first anal ray  $1\frac{1}{3}$ ; length of caudal 1; least depth of caudal peduncle  $1\frac{9}{10}$ ; pectoral  $1\frac{2}{7}$ ; ventral  $1\frac{1}{10}$ . Body deeply rhomboid, compressed, back well elevated, upper profile a little more convex than lower and greatest depth about tip of ventral spine. Caudal peduncle compressed, deep, and least depth about equal to its length. Head deep, compressed, upper profile slightly concave over front of eye, and lower slightly convex. Snout broad, short, and convex. Eye rather large, circular, a little high and posterior. Mouth well inclined, and mandible only slightly projecting. Lips a little fleshy. Maxillary small, reaching front margin of orbit, slipping below preorbital, which is equal in breadth to half of orbit. Distal expanded extremity of maxillary  $\frac{2}{7}$  of orbit. Teeth moderately large, in bands on vomer and palatines and in jaws. Tongue short, rather broad, and free. Each ramus of mandible well elevated inside of mouth. Nostrils separated, lateral, posterior larger and near upper front rim of orbit. Margins of preorbital, suprascapula, and preopercle entire,

former with a bifurcating mucous canal ending in two pores. Opercle with two broad terminal flat spine-like points above, lower most posterior and with a pointed cutaneous flap behind. Gill-opening not quite extending as far anteriorly as front orbital margin. Rakers  $2 + 11$ , short, pointed, about half length of filaments, which are 2 in orbit. Isthmus narrowly compressed, but not trenchant. Scales rather large, finely ctenoid, rather broadly exposed, and not especially small, except on bases of vertical fins. Those along bases of spinous dorsal and anal form low sheaths, and those on bases of rayed fins extend out a short distance between rays. Head scaly except snout, jaws, preorbital, interorbital and branchiostegal regions. Scales on cheek in 8 rows and those on opercle a little larger. Lateral line of simple tubes somewhat concurrent with dorsal profile, and sloping down to middle of base of caudal, high at first along side of caudal peduncle. Spinous dorsal inserted over origin of pectoral, spines graduated to fourth and fifth, which are highest, third but little shorter than tenth, but ninth much shorter, and margin of fin somewhat notched. Soft dorsal inserted a little nearer origin of pectoral than base of caudal, and fin rather high. Spinous anal inserted nearly midway between front margin of pupil and base of caudal, margin of fin notched, and spines graduated to third, which is longest. Soft anal inserted a little behind origin of soft dorsal and similar. Caudal rounded. Pectoral rather small, low, and reaching about opposite tip of depressed pectoral. Ventral inserted about opposite origin of pectoral, first ray longest, reaching base of first anal ray, and spine reaching about  $\frac{4}{5}$  of distance to origin of spinous anal. Vent a little before tip of ventral spine.

Color in alcohol plain pale brownish, fins whitish or paler. A vertical brown bar a little wider than pupil from forehead to orbit, and continued below same across cheek. Another from nuchal region down over opercle and side of chest. A third one from front of spinous dorsal much wider and passing just behind base of pectoral. A fourth from origin of soft dorsal. A fifth across caudal peduncle anteriorly. Opercle with a deep brown blotch about equal to pupil. Iris brownish. Length  $2\frac{7}{8}$  inches. No. 12,818, Academy of Natural Sciences of Philadelphia. Co-

type of *Pomotis chatodon* Baird. Cedar Swamp Creek, Cape May County. Prof. S. F. Baird. Smithsonian Institution, No. 817.

Color in life olivaceous above, and whitish below on abdomen and lower surface of head. Crossing body are 6 transverse bands of deep olive-dusky, and medianly each one is more or less blackish-tinted. First transverse bands from occiput through eye and across cheek, but not crossing distinctly over isthmus. Second band immediately before dorsal down side of head over opercle to thorax, but not meeting its fellow. Third band including first three dorsal spines and membranes to fourth spine, then vertically to side of abdomen just behind root of ventral. Fourth beginning at last dorsal spines and bases of first three dorsal rays, then transversely down to bases of first three anals, and its width greater than others. Fifth band beginning on caudal peduncle just after last dorsal ray. Sixth at base of caudal. Side of body marked with beautiful sky-blue and pale greenish-golden tints, and reddish or bronzed reflections on side of head posteriorly. Dorsals, anals and caudal dilute reddish or pinkish with brownish markings, latter in form of 3 or 4 inclined longitudinal series of bars on spines. Membranes, as of other fins, mostly unmarked. Behind fourth dorsal spine membrane bright pinkish, anteriorly, and about same number of bars on each dorsal ray as on spine. Caudal rays with 4 or 5 indistinctly defined brownish blotches, rather pale on each ray. Anal with about 3 series of blotches of pale brownish on rays, basal series broadest. Spinous fins with blotches larger and more distinct, and also 2 in number, or basally and one terminal to each. Ventral with spine and membrane, also first ray, vermilion. Base of fin and region of second ray jet-black, fin otherwise pale or transparent. Iris beautiful brownish. Jaws pale brownish. These notes from an example taken in the Great Egg Harbor River above May's Landing, where they are very abundant.

These little beauties suggest the tropical damsel fishes (*Pomacentridæ*) in their manner of swimming. This is all the more evident by the surroundings, especially the bunches of submerged sphagnum suggesting the formation, if not the coloration, of a coral reef. They swim in little jerks till the apparent impetus

produced dies out, when another is suddenly made. The fins all erect, the dark bands, and a ruddy tint to the ventral spines and the front of the dorsal produces a beautiful combination. They were easily captured in a dip-net if one followed their course a short distance by scooping up a lot of sphagnum, into which they would usually dart when disturbed. This sunfish is frequently found in the Delaware in the same localities as *Enneacanthus gloriosus*, with which it associates, together with *Ameiurus nebulosus*, *Brama crysolencas*, *Fundulus diaphanus*, *Notropis chalybaeus*, and *Perca flavescens*. I have not at any time found it especially abundant there, seldom more than 4 or 5 being taken during a day. It prefers deep ponds of clear water at times, though I have never taken either it or *Enneacanthus gloriosus* on a hook. It also may be found in weedy streams of several feet in width. When living it is one of the most beautiful of our fishes, some examples being blushed with pink or rosy. It appears to be rather hardy, as I have frequently kept it in aquaria, and on several occasions it was kept alive for some time in the Academy of Natural Sciences of Philadelphia. After a short time the colors seem to fade and lose their brilliancy in captivity. Examples are frequently exposed for sale by aquaria dealers in large cities. It seems to be especially abundant in the cedar-stained streams, and I have examined a large series from pools at the head of the Egg Harbor River, Pool Tolsoms, Cedar Swamp Creek, Camden County, Brown Mills and Trenton.

*Pomotis chatodon* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 324.

*Bryttus chatodon* Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 96.—Abbott, Geol. N. J., 1868, p. 807.—Abbott, Am. Nat., IV, 1870, pp. 101, 102, 106.

*Mesogonistius chatodon* Abbott, Hardwicke's Sci. Gossip, 1871, p. 29, fig. 15.—Abbott, Rep. U. S. F. Com., 1875-76, p. 837.—Jordan, An. N. Y. Acad. Sci., I, 1879, p. 98.—Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132.—Abbott, Nat. Rambles, 1885, p. 477.—Bean, Bull. U. S. F. Com., VII, 1887, p. 142, from Baird.—Cope, Am. Nat., XXX, 1896, p. 943.

Genus *LEPOMIS* Rafinesque.

## The Eared Sun Fishes.

*Key to the species.*

- a.* Supplemental maxillary well developed. PHENAX
- aa.* Supplemental maxillary rudimentary or wanting.
  - b.* No dark blotch on bases of last dorsal and anal rays; opercular flap of adult long and narrow. AURITUS
  - bb.* A dark blotch on bases of last dorsal and anal rays; opercular flap of adult long and wide. PALLADUS

***Lepomis phenax* (Jordan).**

## PLATE 40.

## Deceptive Sun Fish.

Head  $2\frac{1}{2}$ ; depth  $2\frac{1}{15}$ ; D. X, 11, 1; A. III, 10, 1; P. II, 11; V. I, 5; scales 46 in lateral line to base of caudal, 7 scales between origin of spinous dorsal and lateral line, and 15 scales between latter and origin of spinous dorsal; width of head  $2\frac{2}{3}$  in its length; depth of head, over front of orbit,  $2\frac{1}{10}$ ; fifth dorsal spine 3; seventh dorsal ray 2; third anal spine 3; fourth anal ray 2; length of caudal  $1\frac{4}{7}$ ; least depth of caudal peduncle  $2\frac{2}{3}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{5}{6}$ ; snout 4, from tip of upper jaw; eye 5; maxillary  $2\frac{7}{8}$ ; interorbital space 4. Body deep, compressed, rather orbicular, profiles somewhat similar, and greatest depth about middle of depressed ventral. Caudal peduncle compressed, rather deep, and least depth  $1\frac{1}{8}$  in its length. Head rather large compressed, and upper profile slightly concave above upper front of eye. Snout broad, convex, and profile bulging a little on upper. Eye orbicular, a little elevated, and well anterior. Preorbital rather broad, two-thirds diameter of orbit. Maxillary well inclined, mandible protruding a little in front, and posterior edge of maxillary extending a little beyond front orbital rim or not quite opposite front rim of pupil. Supplemental maxillary well developed, though rather small, and distal expanded extremity of maxillary equal to four-sevenths of orbital diameter.

Lips rather fleshy. Teeth pointed, in bands, and an outer enlarged series in each jaw. A patch of small vomerine teeth, and narrow series or band of smaller ones on palatines. Nostrils in a slight depression, separated, posterior near front of eye about level with upper rim of pupil, and anterior with a slight cutaneous rim. Interorbital space a little convex and rather broad. Suprascapula entire. Opercle with a large flap about equal to orbit and somewhat stiffened, so that the osseous portion is distinct from the cutaneous rim, which is, however, very narrow, though of about equal width. Margin of preopercle entire. Gill-opening extending forward till about opposite anterior margin of orbit. Rakers  $13 + 11$ , pointed, a little curved, and longest about five-sixths of longest filaments, which are about four-sevenths of orbit. Isthmus rather narrow, compressed, and with beveled edge. Pharyngeal cavity already partly dissected and teeth similar to those of *Lepomis palladus* (Mitchill) as figured by Mr. Richardson,<sup>1</sup> *i. e.*, conical and pointed, though lower anterior ones more or less rounded. Scales moderately small, rather broadly exposed, in series parallel with lateral line above its course, though in horizontal series below. Scales on head, chest and on and along bases of fins smaller. Interorbital space, snout, jaws, margin of opercle, narrow ocular rim and branchiostegal region naked, head otherwise scaly. Scales on cheeks small, in 6 series. Opercular scales largest of scales on head. Scales along bases of spinous dorsal and anal forming sheaths and those on soft fins smaller, also extending well out between rays. Lateral line of simple tubes, nearly concurrent with dorsal profile, extending a little high on side of caudal peduncle at first, but not on base of caudal. Origin of spinous dorsal a trifle behind that of pectoral, margin of fin notched, spines low and graduated to fifth, after which they are subequal and longer. Soft dorsal higher, inserted about midway between origin of pectoral and base of caudal, and graduated to seventh ray, which is longest. Spinous anal a little nearer base of caudal than posterior margin of eye, margin notched, spines low and graduated to third, which is longest.

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<sup>1</sup> In an able treatise on Illinois Sun Fishes, *Bull. Ill. State Lab. Nat. Hist.*, VII, March, 1904, p. 27.

Soft anal similar to soft dorsal, second ray about longest. Caudal rather small, lobes distinct, rounded, so that edge of fin is a little emarginate. Pectoral low, broad, upper rays longest and almost reaching origin of spinous anal. Ventral inserted a trifle in advance of origin of spinous dorsal and a little behind origin of pectoral. Ventral spine slender, a little more than half length of fin. Depressed ventral reaching about as far posteriorly as tip of depressed pectoral. Vent near origin of anal. Color in alcohol dull brown, back a little deeper in color, and series of very indistinct spots forming longitudinal lines in courses of scales on side of body. Opercular flap with a deep brown blotch about equal to orbit. Fins all plain brown. Iris dull brassy-white. Length 6 inches. No. 13,188, Academy of Natural Sciences of Philadelphia. Type (cotype) of *Apomotis phenax* Jordan. Beesley's Point. Dr. Joseph Leidy. Also another example with same data.

These examples are the only ones known to me and the locality where they were supposed to have been secured has been questioned. The species has never been rediscovered near Beesley's Point, to my knowledge, though at the same time it is possible that it may occur in some of the neighboring fresh waters. Provisionally I shall consider it distinct from *Apomotis ischyryus* (Jordan). Drs. Jordan and Evermann point out distinctive characters, though as yet I have not examined specimens of *A. ischyryus*. The air-vessel of *Lepomis phenax* has not been examined, though in structure it may be found most likely identical with that of species of *Lepomis*.

*Apomotis phenax* Cope and Jordan, in Jordan, Bull. U. S. Nat. Mus., X, 1877, p. 26.—Jordan, An. N. Y. Acad. Sci., I, 1879, p. 100, types.—Jordan and Evermann, Bull. U. S. Nat. Mus., XLVII, I, 1896, p. 999, from types.

*Chænobryttus phenax* Cope, in Jordan, l. c., MS. name only.

*Lepomis phenax* McKay, Proc. U. S. Nat. Mus., III, 1881, p. 88, name only.—Jordan and Gilbert, Bull. U. S. Nat. Mus., XVI, 1882, p. 474, copied.

*Apomotis cyanellus* Boulenger, Cat. Fish. Brit. Mus., Ed. II, I, 1895, p. 21, part.

**Lepomis auritus** (Linnæus).

## PLATE 41.

River Sun Fish. Black Eared Sun Fish. Long Eared Sun Fish.  
Hound Eared Sun Fish. Red Bellied Sun Fish.

Head to end of flap  $2\frac{3}{5}$ ; depth  $2\frac{1}{5}$ ; D. X, 12; A. III, 9, 1; scales 46 in lateral line to base of caudal, and about 4 large ones on latter; 7 scales obliquely back from origin of spinous dorsal to lateral line; 14 scales in an oblique series forward from origin of spinous anal to lateral line; mandible  $2\frac{3}{5}$  in head; eleventh dorsal spine 3; seventh dorsal ray  $2\frac{1}{5}$ ; third anal spine 3; fifth anal ray  $2\frac{1}{5}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; caudal about  $1\frac{3}{5}$ ; pectoral  $1\frac{3}{5}$ ; pectoral  $1\frac{3}{5}$ ; ventral  $1\frac{9}{10}$ ; snout  $4\frac{1}{6}$  in head measured from tip of upper jaw; eye  $4\frac{1}{6}$ ; maxillary 3; interorbital space  $4\frac{1}{8}$ . Body rather elongate, well compressed, and greatest depth at origin of ventral. Back hardly elevated so that both profiles of body are similarly convex. Head a little large, upper profile more inclined than lower. Snout about equal to eye. Orbit circular, about first third in length of head. Mouth a little inclined and gape extending about opposite posterior nostril. Maxillary extending a little beyond front rim of orbit, but not to pupil, without supplemental bone, and its distal expansion equals pupil. Width of preorbital  $\frac{2}{3}$  of orbit. Jaws rather large and lower protruding a little. Teeth in jaws in villiform bands, each with an outer enlarged series of conic teeth. A patch of vomerine teeth, and a few obsolete ones on palatines. Tongue rather broad and free. Lips fleshy. Nostrils near together in front of eye. Interorbital space rather broad and convex. A few blunt serræ at lower edge of preopercle. Opercle ending in a long cutaneous flap directed posteriorly and upwards, much narrower than orbit. Suprascapula entire. Gill-rakers III 1 + 5 IV, short, thick, robust and asperous. Scales on body large, finely ctenoid, becoming reduced and crowded on cheek, breast, predorsal region and bases of vertical fins. Scales on cheek in 8 series. Lateral line of simple tubes and more or less concurrent with dorsal profile. Spinous dorsal begins a little behind origin of ventral,



spines graduated to fourth after which they are more or less subequal, and margin of fin notched. Rayed dorsal inserted a little nearer base of caudal than origin of spinous fin, and its edge rounded. Anal inserted a little nearer base of caudal than origin of pectoral, spines graduated to third which is longest, and fin rounded. Caudal broad, a little emarginate with slightly rounded lobes. Pectoral rather broad, not reaching as far as tip of depressed ventral or only  $\frac{3}{4}$  to spinous anal. Ventral inserted a little behind origin of pectoral, spine about  $\frac{3}{5}$  length of fin, which reaches about  $\frac{3}{4}$  to spinous anal. Vent close in front of spinous anal. In life mostly olive above. Sides tinted with bluish, scales with reddish spots. Head with wavy bluish horizontal lateral stripes, mostly distinct in front of eye in some examples. Opercular flap jet black, fading out anteriorly. Belly and breast bright orange. Fins tinted dusky, sometimes caudal and anal with a slight ruddy tinge. Length 5 inches. Assanpink Creek.

An abundant and familiar fish in the Delaware and its tributaries. The larger examples, the species attaining 8 inches in length, are good pan-fish. It may frequently be taken on a hook baited with the ordinary earth-worm, though it will also take grasshoppers. I have examined a very large series from the Shabbaconk, Crosswicks and the above-mentioned creeks. It was reported to me from Cedar Swamp Creek and the Passaic River.

*Pomotis auritus* Abbott, Rep. U. S. F. Com., 1875-76, pp. 837, 841.

*Lepiopomus auritus* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 99.

*Lepomis auritus* Abbott, Nat. Rambles, 1885, p. 477.

*Ichthelis rubricauda* Abbott, Proc. Acad. Nat. Sci. Phila., 1861, p. 96.—Abbott, Geol. N. J., 1868, p. 807.

*Pomotis appendix* Abbott, Geol. N. J., 1868, p. 807.

*Ichthelis appendix* Abbott, Rep. U. S. F. Com., 1875-76, pp. 835, 837.

**Lepomis palladus** (Mitchill).

PLATE 42.

Blue Sun Fish. Blue Gill Sun Fish. Common Sun Fish.

Distinguished from the preceding chiefly by the large rather broad and wide opercular flap of the adult, and the diffuse blackish blotch at the bases of the posterior dorsal and anal rays.

I have never seen any New Jersey examples. Dr. Abbott records 3 examples from the Delaware tide-water below Trenton, and subsequently several others. Lately Dr. Evermann found it common in Lake Mashipacong. Much doubt appears to be attached to Mitchill's name *Labrus palladus* as applicable to the present species. This is due, as contended by Dr. Bean, to the description and the locality. He suggested that the former more readily approaches *Emmeacanthus* and the latter was not in agreement with the range of *Lepomis palladus*, as then known. Dr. H. M. Smith has also recently objected to Mitchill's name on similar grounds, suggesting *Pomotis incisor* Valenciennes as the oldest name to be used. However, it remains to be proved that Mitchill's fish is not the species now under discussion, especially when its range is now established for the northwestern part of New Jersey and the Delaware basin. From this it may even be expected to be found nearer New York City than formerly supposed, thus strengthening the possibility that Mitchill really did obtain it from no great distance from the metropolis. I shall therefore retain it, aside from the fact of perhaps the lesser principle of current usage which it has gained. There is also no evidence that the original spelling of the specific name of this fish was unintentional, though of course *pallidus* would have been the proper form. In such cases, and where euphonic, it appears a more stable policy to adhere rigidly to the original rather than institute an emendation or accept such from a subsequent writer.

*Lepomis pallidus* Abbott, Nat. Rambles, 1885, p. 477.—Evermann, Recreation, April, 1902, p. 292.

*Ichthelis incisor* Abbott, Rep. U. S. F. Com., 1875-76, p. 837.

## Genus EUPOMOTIS Gill and Jordan.

## The Sun Fishes.

*Eupomotis gibbosus* (Linnæus).

## PLATE 43.

## Sunny. Common Sun Fish.

Head  $2\frac{7}{8}$ ; depth 2; D. X, 11, 1; A. III, 10, 1; scales 40 in lateral line to base of caudal; 7 scales between base of first dorsal spine and lateral line in a vertical series; 14 scales in a vertical series between origin of anal and lateral line; snout  $3\frac{7}{8}$  in head; eye 4; maxillary  $3\frac{1}{4}$ ; interorbital space  $3\frac{1}{8}$ , all these measured from tip of upper jaw; fourth dorsal spine  $2\frac{2}{3}$ ; eighth dorsal ray 2; third anal spine  $2\frac{1}{2}$ ; fifth anal ray 2; upper caudal lobe  $1\frac{1}{6}$ ; least depth of peduncle  $2\frac{1}{4}$ ; pectoral  $1\frac{1}{6}$ ; ventral  $1\frac{1}{7}$ . Body deep, well compressed, comparatively short, and back elevated. Upper anterior profile steep, forming a very obtuse angle above and behind eye. Lower profile less convex than upper. Caudal peduncle deep, compressed. Snout short, obtusely convex. Eye circular, well anterior. Mouth small, a little oblique, and mandible projecting. Maxillary reaching front of eye, without supplemental bone, and its distal expansion about equal to diameter of pupil. Width of preorbital about  $\frac{2}{3}$  of orbit. Lips fleshy. Teeth in jaws in bands, rather conspicuous. Vomerine teeth smaller. Nostrils together, near front of eye. Interorbital space broad, somewhat flattened medianly, otherwise convex. Opercular flap rounded, not produced, and a little smaller than pupil. Gill-rakers 3 + 9 short weak denticles. Pharyngeal bones broad, concave and paved with bluntly rounded teeth. Scales rather large, reduced on predorsal region, along bases of vertical fins and on base of caudal. Scales on chest large, but smaller than those on side of body. Scales on cheek in 4 series. Tubes in lateral line simple. Lateral line more or less concurrent with dorsal profile. Origin of spinous dorsal begins a little behind that of pectoral, spines graduated from fourth, which is longest, though last longer than penultimate, and margin of fin

notched. Rayed dorsal rounded, inserted nearly midway between origin of pectoral and base of caudal. Spinous anal inserted before origin of rayed dorsal, graduated to third spine, which is longest. Rayed anal similar to rayed dorsal. Caudal emarginate, lobes rounded. Pectoral long, reaching origin of anal, pointed, and second branched ray longest. Ventral inserted just behind origin of first dorsal spine, reaching vent which is a short distance in front of anal, and spine a trifle more than half way to origin of anal. Color greenish or olive above with bluish tints, sides blotched and spotted with orange. Opercular flap black, its lower posterior margin scarlet. Side of head with 5 horizontal bright blue wavy stripes. Upper fins with bluish spotted with orange. Lower fins and belly orange. Length  $4\frac{3}{4}$  inches. Crosswicks Creek, near Trenton.

Prevailing color of the adult olivaceous-brown in life becoming golden, especially on chest and side of belly, and also lower surface of head. Head with reticulating lines all over of sky-blue-green, mostly from eye, and also extending on preorbital region and maxillary. Side and back with similar lines darker above and not extending on anal region. Opercle black with creamy-white margin, except posteriorly, where it is bright red. Spinous dorsal grayish-dusky blotched with dusky, these blotches also continued on soft dorsal, which is with deep dusky-golden distally and its margin dull leaden-bluish. Caudal similar, also anal, but with more golden and margin paler blue. Ventral spine golden-dusky or otherwise golden with tips of rays plumbeous. Unpaired vertical fins also with more greenish. Pectoral dark golden. Inside of gill-opening pearl-colored. Iris bronzed-red-dish in some lights, otherwise brown.

Abundant in all our fresh-water streams and one of our most brilliant and beautiful fishes. Sometimes they are found in schools of 20 or 30, usually fewer. They like still waters, often in the submerged grass, and biting at a hook baited with an earth-worm, grasshopper or helgramite. Many examples from New Jersey, from Camden County, Crosswicks Creek near Trenton, the Rancocas Creek near Medford, and Beesley's Point.

*Lepomis gibbosus* Abbott, Nat. Rambles, 1885, p. 477.

*Pomotis aureus* Abbott, Geol. N. J., 1868, p. 807.

*Eupomotis aureus* Jordan, An. N. Y. Acad. Sci., I, 1879, p. 98.



### Family PERCIDÆ.

#### The Perches.

Body more or less elongate, terete or compressed. Mouth terminal or inferior, small or large. Premaxillaries protractile or not. Maxillaries large or small, without distinct supplemental bone. Jaws, vomer and palatines with bands of teeth which are usually villiform, but sometimes mixed with canines. Occasionally teeth on vomer or palatines are absent. Preopercle entire or serrate. Opercles usually ending in a flat spine. Gills 4, a slit behind fourth. Gill-membranes free or connected, not joined to isthmus. Gill-rakers slender, toothed. Pseudobranchiæ small, or glandular and concealed, or altogether wanting. Branchiostegals 6 or 7. Lower pharyngeals separate, with sharp teeth. Air-vessel small and adherent, often entirely wanting. Pyloric cæca few. Vertebrae 30 to 48, always more than 10, 13 to 25 in precaudal portion. Body covered more or less completely with rather small ctenoid adherent scales. Lateral line usually present, not extending on caudal fin. Head naked, or more or less scaly. Preopercle entire or serrate. Fins generally large. Dorsals 2, first of VI to XV spines. Anal fin with I to II spines, usually latter. Caudal lunate, truncate or rounded. Pectoral often very large. Ventral I, 5, thoracic. Anal papilla usually more or less developed.

Fresh-water fishes of the temperate zone, several attaining some size and of value as food-fishes.

#### Key to the genera.

- a. PERCINÆ. Pseudobranchiæ well developed; preopercle serrate; no canines. PERCA
- aa. ETHEOSTOMATINÆ. Pseudobranchiæ imperfect or wanting; preopercle entire.
  - b. Parietal region of skull rather depressed, not strongly convex in transverse section; -shaped in section. PERCINA
  - bb. Parietal region of skull rather depressed, more or less strongly convex in cross-section, thus 
    - c. Cranium broad between eyes; snout projecting. BOLEOSOMA
    - cc. Cranium narrow; snout not much protruded. BOLEICHTHYS

## Genus PERCA Linnæus.

## The Perches.

*Perca flavescens* (Mitchill).

## PLATE 44.

Perch. Peersch. River Perch. Yellow Perch. Yellow Ned.

Head 3; depth  $3\frac{2}{3}$ ; D. XIII-I, 14, 1; A. III, 7, 1; scales 56 in lateral line to base of caudal; 6 scales obliquely back from origin of spinous dorsal to lateral line; 13 scales between origin of spinous anal and lateral line in a vertical series; mandible 2 in head; third branched dorsal ray  $2\frac{1}{2}$ ; third anal spine  $3\frac{1}{4}$ ; first anal ray  $2\frac{1}{2}$ ; upper caudal lobe  $1\frac{4}{7}$ ; least depth of caudal peduncle  $3\frac{3}{5}$ ; pectoral  $1\frac{7}{8}$ ; ventral  $1\frac{7}{8}$ . Body long, compressed and back elevated at origin of dorsal, which is deepest part of body. Caudal peduncle a little long, compressed. Head large, elongate, and muzzle robust. Snout long, convex. Eye circular, anterior. Mouth moderate, oblique, and mandible slightly protruding. Lips rather thick and fleshy. Maxillary falling a little short of posterior margin of pupil and its distal expansion about  $1\frac{1}{4}$  in orbit. Villiform teeth in jaws and on vomer and palatines. Interorbital space rather broad and only a trifle convex. Nostrils a little separated. Opercular spine sharp, 2 smaller denticles below. Preopercular margin serrate, retrorse below. Gill-rakers III 2 + 12 IV, lanceolate, longest about  $1\frac{1}{2}$  in pupil. Scales on predorsal region, breast and cheeks small, in 6 series on latter. Shoulder-girdle, opercle and top of head well striate. Lateral line of simple tubes, high. Spinous dorsal inserted a little behind origin of pectoral, and highest about fourth spine. Rayed dorsal inserted nearer base of caudal than origin of pectoral, anteriorly highest. Anal inserted a little posterior to origin of second dorsal or midway between base of seventh dorsal spine and base of caudal, spines graduated to third, which is longest. Rayed anal deepest anteriorly. Caudal emarginate, upper lobe longer. Pectoral nearly half way to anal. Ventral inserted about opposite base of fourth dorsal spine, and reaching

half way to anal. Spine of ventral  $1\frac{4}{7}$  in fin. Color dark olivaceous above, sides yellowish, and belly pale. About 8 dark broad bars on side of body. Upper fins dull olive, lower fins reddish. Length  $11\frac{1}{4}$  inches. Morris County.

Not so abundant as related forms like *Lepomis auritus*, *Eupomotis gibbosus* and *Boleosoma nigrum olmstedii*, though found in the same localities, frequently about old bridges. A few are said to be in the Great Egg Harbor River above the dam.

*Perca flavescens* Abbott, Geol. N. J., 1868, p. 806.—Abbott, Rep. U. S. F. Com., 1875-76, p. 828.—Abbott, Nat. Rambles, 1885, p. 477.

### Genus PERCINA Haldeman.

#### The Log Perches.

#### *Percina caprodes* (Rafinesque).

PLATE 45.

#### Hog Fish. Sand Perch.

This, the largest of the darters, may be distinguished from our other species by the broad interorbital space and pig-like projecting snout.

I have never seen any New Jersey examples. Dr. Abbott reports it, however, and states that his specimens were pronounced by Haldeman himself to be identical with those named *Percina nebulosa* from the Susquehanna basin.

*Percina caprodes* Abbott, Geol. N. J., 1868, p. 808.—Abbott, Nat. Rambles, 1885, p. 477.

### Genus BOLEOSOMA De Kay.

#### The Tessellated Darters.

#### *Boleosoma nigrum olmstedii* (Storer).

PLATE 46.

#### Darter. Sand Darter. Tessellated Darter.

Head  $3\frac{1}{2}$ ; depth  $5\frac{1}{3}$ ; D. IX-I, 13; A. I, 10; scales 47 in lateral line to base of caudal; 5 scales obliquely back from origin

of spinous dorsal to lateral line; 6 scales in a vertical series between origin of anal and lateral line; snout  $3\frac{1}{2}$  in head; eye  $3\frac{1}{5}$ ; maxillary  $3\frac{1}{8}$ ; fourth dorsal spine  $1\frac{3}{5}$ ; third dorsal ray  $1\frac{1}{2}$ ; fifth dorsal ray  $2\frac{1}{8}$ ; caudal  $1\frac{1}{5}$ ; least depth of caudal peduncle 3; pectoral  $1\frac{1}{8}$ ; ventral  $1\frac{1}{2}$ . Body a little compressed, rather slender and with a long caudal peduncle. Head a little elongate, and upper profile a little convex anteriorly. Cheeks a little swollen. Snout conic. Eye a little longer than deep, well anterior. Upper jaw a little protruding. Teeth fine. Maxillary reaching a little beyond anterior margin of orbit. Teeth minute. Lips rather fleshy. Nostrils well separated, in front of eye. Interorbital space narrow and level. Opercular spine strong. Opercular flap lobate. Gill-rakers + 4 III, short tubercles. Scales large, finely ctenoid, and of more or less uniform size. Scales in 5 rows on cheek. Lateral line of simple tubes, continuous, and sloping down a little till median on side. Spinous dorsal inserted about first fourth in length of pectoral, rounded, and median rays highest. Rayed dorsal inserted a little nearer base of caudal than posterior margin of orbit and highest anteriorly. Anal inserted a little posterior to origin of rayed dorsal and reaching about four-sevenths of space to base of caudal. Caudal rounded, rather long. Pectoral long, reaching beyond ventral or about three-fourths of space to anal. Ventral inserted behind origin of pectoral, and reaching three-fifths of space to anal. Color pale straw-brown, finely mottled with various shades of deeper brown above. Sides blotched with deep brown, some zig-zag. Fins finely barred, ventrals and anal pale. A dusky streak on side of snout from its tip to eye and another down over cheek. Length  $2\frac{1}{16}$  inches. Crosswicks Creek near Trenton.

An adult male  $2\frac{5}{8}$  inches long was dull brown above in life, lower surface pale brownish, becoming white or whitish on ventral or under surface medianly. Upper surface variegated with beautiful wavy markings made up of spots, and darker edges of each scale. These vary from deep brown to pale olivaceous. On back medianly these are seen to take the form of about seven dusky saddles, first one on occiput, second on nape, third at origin of spinous dorsal, fourth at last rays of same, fifth at middle of



base of soft dorsal, sixth at base of last rays of same, and seventh on caudal peduncle. Alternately on side a series of W-like markings along lateral line, below each saddle more or less even, and one opposite each interspace so that there are usually ten or eleven on side. Top of head variegated. A blackish streak below eye down over cheek, another from front of eye to tip of snout. Upper lip black. Opercle variegated with olivaceous-brown and deep metallic green anteriorly. Rest of head and trunk immaculate. Fins all more or less dusky. Dorsals, caudal and pectoral tinted olivaceous. Soft dorsal and caudal with beautiful wavy lines or bars of olive-brown, mostly regular and sharply defined, and edges of fins dusky-slaty. Spinous dorsal mottled with olive-brown. Anal pale slaty, becoming deeper below and marginally. Pectoral with each ray marked at regular intervals with small bars of pale dusky. Ventral with olivaceous-tinted rows, membranes slaty, and inner edge of fin whitish. Male with tips of dorsal spines, pectoral, ventral and anal radii adipose-like or expanded. Iris plumbeous slate-color. An adult female was yellowish straw-color in life, slightly brighter below. Variegations similar to those of male, sometimes pale, and again exceptionally bright and distinct, and also with considerable variation in the same waters. Fins more straw-color, tips slightly adipose-like. Bars on soft dorsal and caudal paler, and markings themselves mostly on radii. Pectoral more ochraceous. Ventral and anal whitish washed with ochraceous. Lips ochraceous, sometimes marked or spotted with dusky or brown. Green on opercle very pale, usually absent. Young similar to female, only usually paler and with fewer spots or small specks. Bars on fins confined to radii and without adipose-like developments.

Abundant in most all of our creeks. They are found most frequently, however, in the smaller streams, usually with sandy bottoms and composed of clear running water, though seldom venturing into rapids. I notice that they also like still shallow pools and may frequently be found in these places resting quietly on their ventral fins, though suddenly darting away a short distance when disturbed, only to remain perfectly motionless until again disturbed. Sometimes as many as a dozen will congregate

in a cavity of some small stream, preferably just below a little rapid, where they behave somewhat like *Rhinichthys atronasmus* and swim against the current. Unlike that fish they dart away at the approach of danger seldom to return. Frequently in such instances they seek the seclusion of a rock or small stone, quickly concealing themselves in crevices. When in the water their colors harmonize so well with their surroundings that it is difficult to distinguish them from the bottom of the stream. Their movements when darting are very sudden or swift, though they usually do not swim far. They will thrive in aquaria and make a most interesting addition. I have never seen one take a small minnow hook properly baited. They appear equally abundant in sandy woodland waters as in those in meadows.

*Bolcosoma olmstedii* Abbott, Geol. N. J., 1868, p. 808.—Jordan, An. N. Y. Acad. Sci., I, 1879, p. 95.—Abbott, Nat. Rambles, 1885, p. 477.—Bean, Bull. U. S. F. Com., VII, 1887, p. 144.

#### Genus BOLEICHTHYS Girard.

##### The Little Darters.

##### **Boleichthys fusiformis** (Girard).

##### PLATE 47.

##### Darter. Crimson Darter. Fusiform Darter.

Head  $3\frac{4}{5}$ ; depth  $5\frac{1}{4}$ ; D. XI-I, 1, 8, 1; A. II, 6; scales 14 in lateral line to end of tubes, 50 to base of caudal, and several more on latter; 3 scales obliquely back from origin of spinous dorsal to lateral line; 11 scales obliquely back from origin of second dorsal to base of second rayed anal; snout 6 in head; eye 4; maxillary  $3\frac{2}{3}$ ; interorbital space  $6\frac{1}{3}$ ; fourth dorsal spine  $1\frac{5}{7}$ ; second branched dorsal ray  $1\frac{5}{7}$ ; third anal ray 2; least depth of caudal peduncle  $2\frac{2}{5}$ ; caudal  $1\frac{1}{10}$ ; pectoral  $1\frac{1}{4}$ . Body elongate, slender, compressed. Head rather narrow, elongate, profiles more or less similar. Muzzle short, convex. Eye a little longer than deep, far anterior. Mouth oblique and jaws even. Maxillary reaching front rim of pupil and its distal expansion a

trifle less than same. Teeth in jaws small. Interorbital space narrow and flat. Nostrils close in front of eye above. Opercular spine strong, and pointed cutaneous flap long, triangular. Pre-maxillaries not protractile. Gill-rakers 1 + 7 short blunt points. Head, except top, snout, jaws and maxillary, scaly, in 6 series on cheek. Scales conspicuously ciliated, small on predorsal region. Lateral line high, short, and only continued till near tip of depressed pectoral. Spinous dorsal inserted over first two-fifths of pectoral, and fin rounded, highest medianly. Rayed dorsal inserted a little nearer origin of pectoral than base of caudal, highest anteriorly and reaching four-sevenths of space to base of caudal. Anal inserted a little posterior to origin of rayed dorsal or about midway between origin of pectoral and base of caudal. Caudal long with rounded edges, and posterior margin a little straight. Pectoral reaching about three-fifths of space to anal. Ventral inserted before spinous dorsal behind origin of pectoral, and reaching about as far posteriorly as tip of pectoral, spine about three-sevenths length of fin. Color deep olivaceous, sides and back dotted and blotched with dusky, paler beneath. Head dark above with dusky dots on sides, and dark line downward and forward from orbit. Base of caudal with a series of 4 dark spots. Dorsal and caudal with narrow bars of blackish. Length  $1\frac{7}{8}$  inches. Crosswicks Creek near Trenton.

In life color is pale translucent drab. Markings deep brown and very distinctly defined. Bronzed green metallic reflections on opercle and prepectoral region. Fins dilute brownish, caudal slightly tinted with ruddy in one example. Peritoneum showing through as silvery. Iris brown with pale silvery or whitish below. This example from Trenton, New Jersey, in May.

Color of an adult in life generally pale olivaceous-brown tinted with dull or dark saffron above and on caudal. A median diffuse deep olive or dusky-slate band from snout to base of caudal, and widening perceptibly on lower half of caudal peduncle. Side of head speckled with similar tints of blackish-brown. Opercle with emerald or golden reflections, and those on preopercular region greenish. Mandible and jaws tinted with saffron. Iris dark brown. Lower surface of head and body pale translucent brown.

abdominal region silvery. Dorsals and anals tinted with dusky, spotted with brownish-dusky on rayed dorsal. On membrane between each dorsal spine an oblique dusky line from base of each preceding spine to distal end of each succeeding. About 6 vertical cross-bars on caudal. Base of anal tinted with dusky. Pectoral and ventral tinted with pale greenish. About 9 pale or indistinct brownish saddles along middle of back, and each also reflected more or less on dark lateral band. Wading River at Speedwell. April 30th, 1904. Several were taken in the dense sphagnum beds and did not appear especially active.

This little fish is found commonly in the lowlands.

*Boleosoma fusiforme* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 328.

*Hololepis fusiforme* Abbott, Geol. N. J., 1868, p. 808.

*Pacilichthys fusiforme* Abbott, Nat. Rambles, 1885, p. 477.

*Boleichthys fusiforme* Bean, Bull. U. S. F. Com., VII, 1887, p. 144.

*Hololepis crochrous* Cope, Proc. Acad. Nat. Sci. Phila., 1864, p. 233.—Abbott, Am. Nat., IV, 1870, p. 718.

*Pacilichthys cæmicus* Abbott, Geol. N. J., 1868, p. 808, evidently lapses for *erochrous*.

*Pacilichthys crochrous* Cope, l. c., 1883, p. 132.—Abbott, Nat. Rambles, 1885, p. 477.

*Microperca punctulata* Abbott, Geol. N. J., 1868, p. 808, evidently young.

### Family SERRANIDÆ.

#### The Sea Bass.

Body oblong, more or less compressed. Caudal peduncle stout. Dorsal and ventral outlines usually not perfectly corresponding. Mouth moderate, or large, not very oblique. Premaxillaries protractile, and broad maxillary usually not slipping for its whole length into a sheath formed by preorbital, which is usually narrow. Supplemental maxillary present or absent. Teeth all conical or pointed, in bands, present on jaws, vomer and palatines. Nostrils double. Preopercle with its margin more or less serrate,

rarely entire. Opercles usually ending in 1 or 2 flat spine-like points. Skull without conical spines and usually without well-developed cavernous structure. No suborbital stay. Post-temporal normal. Second suborbital with an internal lamina supporting globe of eye. Entopterygiod present. All or most of ribs inserted on transverse processes when these are developed. Anterior vertebrae without transverse processes. Gill-membranes separate, free from isthmus. Gills 4, a long slit behind fourth. Gill-rakers long or short, usually stiff, armed with teeth. Pseudo-branchiae present, large. Branchiostegals normally 7, occasionally 6. Lower pharyngeals rather narrow, with pointed teeth, separate. Air-vessel present, usually small and adherent to wall of abdomen. Stomach caecal, with few or many pyloric appendages. Intestines short, as is usual with carnivorous fishes. Vertebrae typically  $10 + 14 = 24$ , number sometimes increased, never more than 35. Body covered with adherent scales of moderate or small size, which are usually but not always ctenoid. Cheeks and opercles always scaly. Lateral line single, not extending on caudal fin. Dorsal spines usually stiff, II to XV in number. Rayed dorsal with 10 to 30 rays. Anal fin rather short, its soft rays 7 to 12, its spines if present always III, sometimes altogether wanting. Pectoral well developed, with narrow base, rays branched. Ventral I, 5, thoracic, normally developed and without distinct axillary scale. Caudal fin variously formed.

Carnivorous fishes, chiefly marine, and found in all warm seas.

*Key to the genera.*

- a. MORONINÆ. Dorsal fins 2.
  - b. Dorsals separate; A. III, 12. ROCCUS
  - bb. Dorsals joined; A. III, 9. MORONE
- aa. Dorsal fin single, sometimes deeply divided.
  - c. EPINEPHELINÆ. A distinct supplemental maxillary. EPINEPHELUS
  - cc. SERRANINÆ. No supplemental maxillary.
    - d. Smooth area on top of cranium very short and small. CENTROPRISTES
    - dd. Smooth area on top of cranium very large, longer than low supra-occipital crest, which is low and short. DULES

Genus *Roccus* Mitchill.

## The Striped Bass.

*Roccus lineatus* (Bloch).<sup>1</sup>

## PLATE 48.

## Rock Fish. Rock. Striped Bass.

Head 3; depth  $3\frac{7}{8}$ ; D. IX-I, 12, 1; A. III, 11, 1; scales 56 in lateral line to base of caudal, and 5 more on latter; 8 scales between origin of spinous dorsal and lateral line in a vertical series; 12 scales in a vertical series between origin of spinous anal and lateral line; mandible  $2\frac{1}{10}$  in head; fourth dorsal spine  $2\frac{2}{5}$ ; first dorsal ray 2; third anal spine  $3\frac{3}{4}$ ; third anal ray  $2\frac{1}{2}$ ; least depth of caudal peduncle  $3\frac{1}{2}$ ; upper caudal lobe  $1\frac{1}{3}$ ; pectoral  $2\frac{1}{2}$ ; ventral  $2\frac{1}{3}$ ; snout 4 in head measured from tip of upper jaw; eye  $3\frac{1}{2}$ ; maxillary  $2\frac{2}{3}$ ; interorbital space  $4\frac{1}{3}$ . Body rather elongate, compressed, and greatest depth at origin of spinous dorsal. Back little arched. Head subconical, profiles similar. Snout conic. Eye a little elongate, anterior. Mouth large a little oblique, and mandible protruding. Maxillary reaching past front rim of pupil or about first third of orbit, and its distal expansion  $1\frac{1}{2}$  in pupil. Teeth fine, in bands in jaws. Teeth on base of tongue in 2 parallel patches. Nostrils close together in front of eye above. Interorbital space wide and a little convex. Margin of preorbital, subopercle and suprascapula entire. Margin of preopercle weakly serrate. Gill-rakers 6 + 15, long, slender and longest about equals pupil. Scales ctenoid, mostly of even size, minute and reduced on base of caudal. Lateral line of simple tubes mostly concurrent with back. Origin of spinous dorsal midway between tip of snout and base of last dorsal ray, spines graduated from fourth which is longest. Rayed dorsal inserted midway between posterior margin of preopercle and base of caudal, and graduated down from first ray which is highest.

<sup>1</sup>For an interesting account, see Mease, Trans. Lit. Philos. Soc. N. Y., I, 1815, p. —.

Anal inserted about midway between origin of ventral and base of caudal, spines graduated to third which is longest, and first rays elongated so that fin is similar to rayed dorsal. Caudal deeply emarginate, lobes pointed. Pectoral short, rounded. Ventral inserted behind pectoral, though before spinous dorsal and reaching a trifle over half way to anal. Back dull or pale olive-brown. Lower surface mostly silvery. About 7 narrow lines of darker shade than body-color along courses of scales, from head to caudal, those on back most distinct. Fins pale, dorsals and caudal darker. Length  $3\frac{1}{4}$  inches. Cape May.

Common on our coasts and in the Delaware tide-water. In the spring it ascends rivers for the purpose of spawning. One of the most important of our food and game fishes. Its flesh is of excellent flavor, white, firm and flaky. It has been known to reach a weight of 112 pounds which, however, is exceptional.

*Labrax lineatus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 321.

*Roccus lineatus* Abbott, Geol. N. J., 1868, p. 806.—Abbott, Am. Nat., IV, 1870, p. 104.—Verrill, Am. Nat., V, 1871, p. 397.—Abbott, Rep. U. S. F. Com., 1875-76, pp. 830, 832.—Jordan An. N. Y. Acad. Sci., T, 1879, p. 97.—Abbott, Nat. Rambles, 1885, p. 477.—Bean, Bull. U. S. F. Com., VII, 1887, p. 144.—Moore, Bull. U. S. F. Com., XII, 1892, p. 361.—Smith, Bull. U. S. F. Com., XII, 1892, p. 375.

#### Genus MORONE Mitchill.

#### The White Perch.

*Morone americana* (Gmelin).

PLATE 49.

Perch. Peerch. White Perch. Yellow Perch.

From those bass with supplemental maxillary, such as the preceding species, this may be distinguished by having the two distinct dorsal fins joined.

A common food-fish taken along our coast principally in water about Cape May. It is abundant in the Delaware tide-water and

an object of sport to the river angler. Although they sometimes exceed a foot in length they generally run smaller and are therefore used more as a pan-fish. They become landlocked in ponds and are said to be much darker in color in such places.

*Morone americana* Abbott, Geol. N. J., 1868, p. 806.—Abbott, Am. Nat., IV, 1870, p. 104.—Abbott, Rep. U. S. F. Com., 1875-76, pp. 830, 835.

*Morone americana* Verrill, Am. Nat., V, 1871, p. 398.

*Roccus americanus* Abbott, Nat. Rambles, 1885, p. 477.—Bean, Bull. U. S. F. Com., VII, 1887, p. 144.

*Labrax mucronatus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 322.

## Genus EPINEPHELUS Bloch.

### The Groupers.

#### **Epinephelus morio** (Valenciennes).

PLATE 50.

#### Grouper. Red Grouper.

From the other known species of this family on our coast having a single dorsal fin this one may be identified by the presence of a supplemental maxillary and the inner depressible or hinged teeth in the jaws.

Dr. Abbott has 2 records for this species on our coast. It is a most abundant and important food-fish in tropical America, reaching a length of 3 feet. On our coast it is a straggler, most likely in the Gulf Stream.

*Epinephelus moris* Abbott, Geol. N. J., 1868, p. 806.

*Epinephelus erythrogaster* Abbott, l. c.

## Genus CENTROPRISTES Cuvier.

### The Black Sea Bass.

#### **Centropristes striatus** (Linnæus).

PLATE 51.

#### Black Sea Bass. Black Bass. Sea Bass. Black Fish.

Head  $2\frac{3}{7}$ ; depth  $2\frac{5}{7}$ ; D. X, II, 1; A. III, 6, 1; scales 44 in lateral line to base of caudal, and 5 more on latter; 6 scales



obliquely back from origin of spinous dorsal to lateral line; 13 scales in a vertical series between origin of spinous anal and lateral line; mandible  $2\frac{1}{10}$  in head; third dorsal spine  $2\frac{1}{2}$  seventh dorsal ray  $1\frac{3}{7}$  third anal spine  $4\frac{1}{5}$ ; fifth anal ray 2; middle of pectoral  $1\frac{1}{3}$ ; least depth of caudal peduncle 3; pectoral  $1\frac{3}{5}$ ; ventral  $1\frac{3}{5}$ . Body robust, back somewhat elevated anteriorly. Head large, thick, little compressed. Snout conic, profile straight. Eye circular, a little anterior. Mouth low, large, little oblique and mandible projecting. Maxillary long, reaching middle of eye and its distal expansion  $\frac{2}{3}$  of orbit. Teeth fixed in broad bands, and canines small. Nostrils separated, anterior a little behind middle of length of snout, circular, and with a short cutaneous flap. Interorbital space convex. Margin of preopercle finely serrate. Gill-rakers II 7 + 4 III, thick, pointed, longest  $1\frac{1}{2}$  in orbit. Scales rather large and ctenoid. About 11 series of scales on cheek. Top of head naked. Spinous dorsal inserted over origin of pectoral, graduated from third and fourth spines which are longest, each provided with short terminal cutaneous points, and edge of fin deeply notched. Rayed dorsal inserted a little nearer origin of pectoral than base of caudal, seventh ray longest and at same region and posterior ends of radii largely free. Anal inserted a little nearer origin of pectoral than base of caudal, spines graduated to third which is longest, and rayed anal similar to rayed dorsal with fifth ray longest. Caudal slightly double concave with its angles produced and longest ray not exerted for a distance equal to length of fin. Pectoral long, not quite reaching anal and radii of upper half truncate behind. Ventral inserted a little before pectoral, and a little more than  $\frac{3}{4}$  to anal. Color blackish, more or less mottled, with paler longitudinal streaks along rows of scales. Dorsal with a series of elongate whitish spots forming oblique light stripes. Length  $15\frac{1}{4}$  inches. Angleasea.

Color in life blackish-brown. Mandible purplish. Shoulder-girdle and inside of gill-opening gamboge-yellow. Iris pearly-orange. Lower eyelid deep green. Lines along snout from its tip to eye and below same deep russet, also traces of dull greenish-purplish or brownish, margin of each scale brownish, forming a reticulated pattern, and that on costal region more or

less shot with golden. Traces of 6 indistinct vertical blotches on back. Dorsal blackish-slaty, margin of rayed fin and tip of spinous flaps pale plumbeous, somewhat milky in hue. Three series of pale plumbeous spots or streaks on spinous dorsal, lowest at and on base of each spine. Four small or irregular ones on rayed dorsal. Margin of caudal broadly pale, and each corner posteriorly paler or whiter than rest of fin, which is mottled with brownish and plumbeous. Anal blackish-plumbeous, paler marginally, and also with a deep bottle-green tint. Ventral similar, and both fins conspicuously margined with pale plumbeous. Pectoral dusky basally, and distally rusty-umber. When freshly caught they are almost uniform black above, the belly becoming translucent-whitish with a greenish-white tint, and the other colors fading accordingly as described above. Grassy Sound.

An abundant food-fish on our coast reaching a length of 18 inches and a weight of 3 pounds. The flesh is of excellent flavor, firm and white. I have examined many examples from Cape May, Anglesea, Stone Harbor, Grassy Sound, Sea Isle City, Ocean City and Atlantic City.

*Centropristes striatus* Moore, Bull. U. S. F. Com., XII, 1892, p. 361.—Smith, Bull. U. S. F. Com., XII, 1892, p. 375.

*Centropristis nigricans* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 323.

*Centropristis nigrescens* Abbott, Geol. N. J., 1868, p. 806.

*Centropristis furvus* Bean, Bull. U. S. F. Com., VII, 1887, p. 143, Pl. 3, fig. 12.

### Genus DULES Cuvier.

#### The Coachman Fishes.

#### **Dules auriga** Cuvier.

#### Coachman.

From the preceding this may be distinguished by its lunate caudal. The skin of the vertex when removed from the cranium will show a large smooth area.

Known only from Dr. Abbott's record of an example at that time in the Academy of Natural Sciences of Philadelphia and labelled from Cape May. I have, however, been unable to locate the specimen. It, like other tropical American fishes, is probably a waif of the Gulf Stream.

*Dules auriga* Abbott, Geol. N. J., 1868, p. 807.

### Family PRIACANTHIDÆ.

#### The Catalufas.

Body oblong or ovate, compressed. Head deep. Eye very large, forming about  $\frac{1}{2}$  length of side of head. Mouth large, very oblique, lower jaw prominent. Villiform teeth on jaws, vomer and palatines, none on tongue. Premaxillaries protractile. Maxillary broad, without supplemental bone, not slipping under very narrow preorbital which is usually serrate. No suborbital stay. Posterior nostril long, slit-like, close to eye. No barbels. Preopercle more or less serrated, 1 or more strong spines at angle. Opercle very short, ending in 2 or 3 points behind. Gill-membranes separate, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers long. Branchiostegals 6. Air-vessel large. Pyloric cœca few. Vertebrae in reduced number, 9 or 10 + 13 = 22 or 23, first vertebra being very small or absent. Transverse process beginning on seventh (sixth) vertebra, last 2 precaudal bridged across. Ribs attached to transverse processes. Epi-pleurals absent on last 3 precaudal vertebrae. Supraoccipital crest very low, continued forward to over front of orbit where it is joined by parietal crests. Processes of premaxillaries moderate. Body covered with small firm rough scales. All parts of body, even snout and maxillary, densely scaly. Each scale with a more or less developed plate on its posterior border, and most developed in young. Spines of fins generally rough, with small serræ. Lateral line continuous, not extending on caudal. Dorsal fin continuous, X spines depressible in a groove, 9 to 15. Anal II, 9 to 15, rayed part long, similar to rayed dorsal. Spines strong. Caudal truncate or lunate. Pectoral small, pointed, not symmetrical, of 19 or 20 rays, upper longest.

Ventrals large, thoracic, I, 5; close together in advance of base of pectoral, joined to belly by a membrane which incloses a groove. No axillary process and spine strong.

Carnivorous fishes of tropical seas, chiefly in deep water and mostly rose-colored in life. One species straying to our shores.

Genus PSEUDOPRIACANTHUS Bleeker.

The Rough Catalufas.

**Pseudopriacanthus altus** (Gill).

PLATE 52.

Head  $2\frac{1}{3}$ ; depth  $1\frac{1}{7}$ ; D. X, 11; A. III, 10; scales 44 in lateral series to base of caudal, 3 more on latter; about 35 pores in lateral line; snout  $3\frac{3}{4}$  in head measured from tip of upper jaw; eye  $2\frac{1}{10}$ ; maxillary  $1\frac{3}{5}$ ; interorbital space  $3\frac{7}{8}$ ; seventh dorsal spine  $1\frac{1}{2}$ ; third dorsal ray  $1\frac{3}{5}$ ; third anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle 3; pectoral  $1\frac{3}{4}$ ; ventral spine  $1\frac{3}{4}$ . Body deep, compressed, nearly ellipsoid. Caudal peduncle small, about as deep as long, compressed. Head deep, strongly compressed, upper profile steep and nearly straight. Snout short, broad. Eye large, circular. Mouth large, obliquely vertical, and mandible projecting. Maxillary oblique, reaching middle of orbit and greatest expansion about half of same. Teeth in jaws villiform, outer series enlarged, and those of larger size on mandible larger than outer series above. Subopercle, preopercle, opercle and preorbital with serrate edges. Two small spines at angle of preopercle and one on opercle. Gill-rakers  $9 + 18$ , slender and as long as filaments. Head and body covered with rough scales, smaller on former and thick on maxillary. Lateral line strongly arched toward base of fifth dorsal spine, then sloping down to caudal peduncle. Dorsal begins close behind posterior margin of orbit, and posterior spines highest. Anal spines long and subequal. Pectoral rounded, reaching anal. Ventral reaching base of third anal spine. Color faded brownish, perhaps bright red in life. Ventrals blackish on outer portions. Length nearly 3 inches. Atlantic City.

This account from the only example I have seen. It is evidently a rare straggler to our coasts by means of the Gulf Stream.

*Priacanthus altus* Cope, Proc. Acad. Nat. Sci. Phila, 1870, p. 121.

### Family LOBOTIDÆ.

#### The Triple Tails.

Body oblong, compressed, equally developed above and below. Snout short. Eye anterior. Palate edentulous. Vertebrae 24, 12 abdominal and 12 caudal, fifth to eleventh with short but gradually lengthening parapophyses projecting sideways and behind downward, and twelfth with elongated parapophyses elongated converging at their extremities and fitting into a groove of first hæmal spine, costiferous pits excavated obliquely in developed parapophyses and gradually ascending forward on vertebrae and finally on neurapophyses. Skull with frontal portion broad, expanded forward and outward, and entering into posterior borders of orbits which are advanced far forward. Postfrontals elongated forward and underlying frontals. Ethmoid short, decurved, and expanded sideways. No vomerine and palatine teeth. Fore part of head very short. Preopercle strongly serrate. Branchiostegals 6. Air-vessel present. Pyloric cœca 3. Dorsal fin continuous with XII spines which may be depressed in a shallow groove. Soft rays of dorsal and anal elevated. Anal spines graduated. Bases of soft dorsal and anal thickened and scaly. Caudal rounded.

A single species, a large fish closely related to the *Serranidæ*.

#### Genus LOBOTES Cuvier.

#### The Triple Tails.

#### *Lobotes surinamensis* (Bloch).

#### PLATE 53.

Triple Tailed Perch. Triple Tail. Black Perch. Black Grunt.

Head about  $3\frac{1}{8}$ ; depth about  $2\frac{1}{5}$ ; D. XI, I, 17, according to figure, 27 according to description; A. III, II, according to figure

and 13 according to description; pectoral 13 on figure, 15 in description; ventral I, 6 on figure and 6 in description; snout  $3\frac{1}{2}$  on figure, measured from tip of upper jaw; eye about 6; maxillary  $2\frac{1}{2}$ ; first dorsal spine 3; sixth dorsal ray about  $1\frac{1}{2}$ ; third anal spine about  $3\frac{7}{8}$ ; eighth anal ray about  $1\frac{7}{8}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; caudal about  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{3}$ ; ventral spine  $1\frac{3}{4}$ ; first ventral ray  $1\frac{3}{4}$ ; branchiostegals 6. Body rather oblong. Head rather small. Snout rather elongated. Eyes rather small. Mouth moderate. Lower jaw rather jutting, and acutely toothed. Upper jaw also armed with a row of sharp teeth. Tongue broad, smooth, with clouded edges. A dark membrane of semi-lunar form inside mouth, immediately within teeth of lower jaw. Near extremity of latter 4 bronzed spots. Gill-cover tripartite, scaly. Posterior edge of foremost lamina strongly aculeated, almost spinous. A bony plate with serrated edge behind gill-opening. Another with similar edge above gill-opening. A knob or gibbosity in front of dorsal fin. Lateral line bending upward, somewhat irregularly at first, then with an easy slope to tail. Scales form a firm coating. First XI radii of dorsal spinous, rather ramentose. Posterior radii of dorsal and anal much lengthened to resemble caudal, giving appearance somewhat of 3 tails. First III anal radii spinous, also first of ventral. Ventral fin stout and strong. Pectoral delicate and weak. Tail convex and rounded. Color of back and sides rusty-black. Belly dirty clay variegated with blackish and yellowish specks. Dull yellow behind eye above gill-cover, along insertion of dorsal, beginning of lateral line, and under pectoral. Dorsal, anal and ventral tinted yellowish amid inky suffusion. Pectoral pale, semi-transparent or very faintly yellow. Whitest part of fish below pectoral. Iris purple or amethystine color. Length  $13\frac{1}{2}$  inches. July 23d, 1814. Along Jersey shore, near Prowles-Hook.

(Mitchill.)

A large food-fish, reaching 3 feet in length, of sluggish habit, and usually a straggler on our coast from tropical America. The young are quite unlike the adult. I have not seen any New Jersey examples.

*Lobotes surinamensis* Abbott, Geol. N. J., 1868, p. 810.

*Bodianus triourus* Mitchill, Tr. Lit. Philos. Soc. N. Y., I, 1815, p. 418, Pl. 3, fig. 3.

## Family LUTIANIDÆ.

## The Snappers.

Body oblong or more or less elevated. Head large, crest on skull usually largely developed. Mouth moderate or large, usually terminal, low and horizontal. Premaxillaries moderately protractile, spines not extending to occiput. Maxillary long, without supplemental bone, for most of its length slipping under edge of preorbital, which forms more or less distinct sheath and its form essentially as in *Serranidæ*. Teeth various, unequal and sharp, never incisor-like, some of them sometimes molar. Vomer and palatines usually with villiform teeth, these sometimes molar, very small and wanting. Preopercle serrate or entire. Opercle without spines. No suborbital stay. Gills 4, a slit behind fourth. Gill-membranes separate, free from isthmus. Gill-rakers moderate or long, slender. Pseudobranchiæ large. Lower pharyngeals separate. Air-vessel present, usually simple. Intestinal canal short. Pyloric cæca few. Vertebrae usually  $10 + 14 = 24$ . No distinct tubercles from cranium for articulation of epipharyngeal bones. Enlarged apophyses for articulation of palatine and pre-orbital bones. Anterior 4 vertebrae without parapophyses. Body covered with moderate-sized adherent scales, more or less strongly ctenoid or almost cycloid. Lateral line well developed, concurrent with back and not extending on caudal. Dorsal fin single, continuous, or deeply notched, sometimes divided into 2 fins, spines usually strong, depressible in a groove, heteracanthous, and X to XII in number. Anal similar to rayed dorsal, with III spines. Caudal usually more or less concave behind. Ventral fins thoracic, rays I, 5, with a more or less distinct scale-like appendage at base.

A large family of active voracious carnivorous shore-fishes of warm regions. All are valued as food-fishes. Two species occur on our shores.

## Genus LUTIANUS Bloch.

## The Snappers.

*Key to the species.*

- a.* Anal rounded, middle rays less than half of head.  
*aa.* Anal angulated, middle rays at least half of head.

GRISEUS  
BLACKFORDII

*Lutianus griseus* (Linnæus).

## Snapper.

Head  $3\frac{1}{3}$ ; depth  $3\frac{1}{2}$ ; D. IX, 13; A. III, 8; scales about 52 to base of caudal; 6 scales between origin of spinous dorsal and lateral line; 12 scales between origin of spinous anal and lateral line; mandible  $2\frac{1}{10}$  in head; fourth dorsal spine  $2\frac{2}{3}$ ; third anal spine  $4\frac{3}{5}$ ; second dorsal ray  $3\frac{1}{4}$ ; second anal ray  $3\frac{1}{3}$ ; least depth of caudal peduncle 3; ventral  $1\frac{5}{7}$ ; snout  $2\frac{1}{2}$  in head, measured from tip of upper jaw; eye  $5\frac{1}{2}$ ; maxillary 3; interorbital space  $3\frac{2}{3}$ . Body elongate, and back little compressed or elevated. Head small, compressed, and upper profile nearly straight from tip of snout to nape. Snout rather long, pointed. Eye circular, a trifle anterior. Mouth large, and mandible strongly projecting. Maxillary oblique, reaching posterior nostril, and falling well short of front of orbit. Distal expansion of maxillary about  $\frac{3}{5}$  of orbit. Upper jaw with a narrow band of villiform teeth with an outer series of enlarged teeth. Upper jaw with 5 canines in front, several quite large. Margin of preopercle with slight irregular denticles, its posterior edge barely emarginate. Interorbital space convex. Scales large, rows in horizontal series below lateral line. Rows above lateral line parallel with it at first, though irregular or slightly oblique below soft dorsal. Cheek with 6 rows of scales. Top of head, snout and jaws naked. Bases of all fins more or less scaly, especially caudal. On dorsal and anal a patch of small scales before base of each spine or ray. Scales on predorsal region and along bases of fins reduced in size. Tubes of lateral line branched. Spinous dorsal inserted a little behind ventral, margin slightly convex, so that fin is graduated from fourth spine, which is longest. Rayed dorsal inserted before anal or a little nearer base of caudal than orbit. Anal spines graduated to third, which is longest, and rayed fin higher. Caudal large, deeply lunate, and upper lobe longer or about  $2\frac{1}{2}$  in rest of body. Pectoral graduated from fifth ray, which reaches  $\frac{3}{4}$  to anal. Ventral inserted behind pectoral and reaching a little over half way to anal. Olivaceous above, paler beneath. Length  $20\frac{5}{8}$  inches. Anglesea.



The above account from an example secured by Mr. Philip Laurent, of Philadelphia. It is the only one from New Jersey I have seen.

*Lutjanus griseus* Bean, Bull. U. S. F. Com., VII, 1887, p. 143, from Baird.

*Lobotes emarginatus* Baird and Girard, in Baird, 9th An. Rep. Smiths. Inst., 1854, p. 332.

*Neomanis emarginatus* Abbott, Geol. N. J., 1868, p. 810.

***Lutianus blackfordii* (Goode and Bean).**

PLATE 54.

Red Snapper.

Distinguished from the preceding by the angulated anal with its median rays produced, longest in adult, at least half of head.

Known from Dr. Smith's account, and said to be casual, however, in the pound-nets.

*Lutjanus blackfordii* Smith, Bull. U. S. F. Com., XII, 1892, p. 375.

**Family HÆMULIDÆ.**

The Grunters.

Body oblong or more or less elevated. Head large, crests of skull usually largely developed. Mouth large or small, usually terminal, low and horizontal. Premaxillaries protractile, their spines not greatly produced backwards. Maxillary without supplemental bone, for most of its length slipping under edge of pre-orbital, which forms a more or less distinct sheath. Preorbital usually broad. No barbels. Teeth all pointed, none forming marked canines. No teeth on vomer, palatines and tongue. Preopercle serrate or entire. Opercle without spines. Gill-membranes separate, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers moderate. Pseudobranchiæ large. Lower pharyngeals separate, with pointed teeth. Branchiostegals usually 6 or 7. Air-vessel present, usually simple. Stomach cæcal. Pyloric

cœca few. Vertebræ usually  $10 + 14 = 24$ . Intestinal canal short. Cranium with muciferous system moderately developed or rudimentary. No suborbital stay. Body covered with moderate-sized adherent scales, more or less strongly ctenoid or almost cycloid. Lateral line well developed, concurrent with back, usually not extending on caudal fin. Sides of head usually scaly. Dorsal fin single, continuous or deeply notched, sometimes divided into 2 fins, spines usually strong, depressible in a groove. Dorsal spines heteracanthous, usually X to XII in number. Anal fin similar to rayed dorsal, with III spines. Caudal usually more or less concave behind. Ventrals I, 5, thoracic, with a more or less distinct scale-like basal appendage.

Carnivorous fishes of warm seas mostly valued as food. Several species recorded from our shores.

### *Key to the genera.*

- |   |              |
|---|--------------|
| a. Mouth more or less wide, jaws scarlet posteriorly in life; rayed dorsal, anal and caudal densely scaled to their tips. | HÆMULON      |
| aa. Mouth more or less narrow, not scarlet inside.  |              |
| b. Anal short, III, 7 to III, 10.   | ANISOTREMUS  |
| bb. Anal long, III, 10 to III, 13.  | ORTHOPRISTIS |

### Genus HÆMULON Cuvier.

#### The Grunts.

#### *Hæmulon plumieri* (Lacépède).

PLATE 55.

#### Squirrel Fish. Grunt.

Distinguished from the other species found on our coast by the rayed vertical fins densely scaled to their margins.

Known from an example recorded by Dr. Abbott from Delaware Bay, taken in July, 1867. However, as the above vernacular is more properly affiliated with *Diplectrum formosum* (Linnæus), one of the *Serranida*, together with the fact that *Perca formosa* Linnæus has been partly confused with the present

species, it is somewhat questionable if it is not *mal a propos* in this instance. In either case, however, their occurrence on our coast is to be attributed to the Gulf Stream, so that they would probably be nothing more than accidental stragglers.

*Hæmulon formosum* Abbott, Geol. N. J., 1868, p. 810.

### Genus ANISOTREMUS Gill.

#### The Pork Fishes.

#### **Anisotremus virginicus** (Linnæus).

#### PLATE 56.

This may be identified by the outer portions of the vertical fins being naked and with 10 or 11 branched rays.

Included on the authority of Dr. Abbott, who met with an example in the Trenton fish market, said to have been received from Barnegat. He also stated that an occasional example has been taken on our coast. A tropical American fish wandering north in the Gulf Stream occasionally.

*Anisotremus virginicus* Abbott, Geol. N. J., 1868, p. 810.

### Genus ORTHOPRISTIS Girard.

#### The Pig Fishes.

#### **Orthopristis chrysopterus** (Linnæus).

#### PLATE 57.

#### Speckled Red Mouth.

Head  $2\frac{5}{6}$ ; depth 3; D. XI, I, 16, 1; A. III, 13, 1; scales about 67 in lateral line to base of caudal, and 2 more on latter; about 11 scales obliquely back from origin of spinous dorsal to lateral line; 16 scales obliquely forward from origin of spinous anal to lateral line; mandible about  $2\frac{1}{2}$  in head; snout  $3\frac{1}{8}$  in head measured from tip of upper jaw; eye  $3\frac{2}{5}$ ; maxillary 3; fourth dorsal spine 2; eighth dorsal ray  $2\frac{1}{3}$ ; third anal spine  $3\frac{1}{8}$ ; third anal ray 2;

upper caudal lobe  $1\frac{1}{5}$ ; least depth of caudal peduncle 3; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{4}{5}$ . Body elongate-ovate, profiles similar. Head large, deep, its profiles similarly convex. Snout convex. Eye circular, anterior. Mouth moderate, and mandible protruding. Maxillary oblique, about reaching front rim of orbit, and its distal expansion about  $\frac{2}{3}$  of pupil. Scales small, none crowded on bases of vertical fins except caudal, and large or in 6 rows on cheek. Lateral line concurrent with dorsal profile. Spinous dorsal inserted a little behind origin of pectoral, graduated from fourth spine, though third and fifth subequal. Base of first dorsal ray about midway between that of first dorsal spine and that of last ray, and graduated from about ninth ray so that fin is higher posteriorly. Spinous anal inserted nearly opposite base of second dorsal ray or about midway between posterior margin of preopercle and base of caudal, third spine longest, though second but little shorter. Rayed anal highest anteriorly, last ray about  $\frac{2}{5}$  length of third. Caudal emarginate, lobes rounded. Pectoral reaches  $\frac{4}{5}$  to anal. Ventral inserted opposite origin of spinous dorsal. A dark stripe beginning on nape and dividing sends one branch along back on each side not far from dorsal outline. A dark stripe from eye to root of caudal. Cheek and opercle with several narrow orange stripes. A narrow orange stripe between the 2 dark body stripes and another below lower dark stripe. Below second orange stripe sides marked with numerous orange spots, not continuous. Length  $1\frac{1}{4}$  inches, and same color persists till 2 inches in length. Beesley's Point. (From Bean.)

I have no examples. It is a good food-fish and is found on sandy shores reaching a length of 15 inches.

*Hæmulon chrysopteron* Abbott, Geol. N. J., 1868, p. 810.

*Orthopristis chrysopterus* Bean, Bull. U. S. F. Com., VII, 1887, p. 142, Pl. 3, fig. 11.

*Orthopristis fulvo-maculatus* Abbott, Geol. N. J., 1868, p. 810.

### Family SPARIDÆ.

#### The Porgies.

Body oblong or more or less elevated. Head large, crests of skull usually largely developed. Mouth small, terminal, low and horizontal. Premaxillaries little protractile. Maxillary short,

peculiar in form and in articulation, without supplemental bone and slipping for most of its length under edge of preorbital, which forms a more or less distinct sheath. Preorbital usually broad. Teeth strong, those in front of jaws conical, incisor-like or molar. Lateral teeth of jaws always blunt and molar. No teeth on vomer or palatines. Posterior nostril largest, usually more or less oblong or slit-like. Preopercle entire or serrate. Opercle without spines. Gill-membranes separate, free from isthmus. Gills 4, a large slit behind fourth. Gill-rakers moderate. Pseudobranchiæ large. Lower pharyngeals separate. Air-vessel present, usually simple. Pyloric cœca few. Vertebræ usually  $10 + 14 = 24$ . Intestinal canal short. No suborbital stay. Body covered with rather large adherent scales, never truly ctenoid. Sides of head usually scaly. Lateral line well developed, concurrent with back, not extending on caudal. Dorsal fin single, continuous, or deeply notched, spines usually strong, and depressible in a groove. Dorsal spines heteracanthous, X to XIII in number. Anal rather short, similar to rayed dorsal, with III spines. Caudal usually more or less concave. Ventrals I, 5, thoracic, and with a more or less distinct scale-like basal appendage.

Carnivorous shore-fishes of the tropical seas, and most valued as food. Several species on our coast.

### *Key to the genera.*

- |  |             |
|--|-------------|
| a. Second interhæmal bone enlarged, hollowed anteriorly or pen-shaped, receiving posterior end of air-vessel in its anterior groove. | STENOTOMUS  |
| aa. Second interhæmal spine normal, not pen-shaped.  |             |
| b. Incisors conspicuously notched.   | LAGODON     |
| bb. Incisors entire or shallowly notched.  | ARCHOSARGUS |

### Genus STENOTOMUS Gill.

#### The Scups.

*Stenotomus chrysops* (Linnæus).

PLATE 58.

Porgée. Porgy. Big Porgy. Scup. Sand Porgée.

Head  $3\frac{1}{5}$ ; depth  $2\frac{1}{8}$ ; D. I, XII, 12, 1; A. III, 11, 1; scales 50 in lateral line to base of caudal; 8 scales between origin of

spinous dorsal and lateral line; 15 scales in a vertical series between origin of spinous anal and lateral line; snout  $2\frac{1}{10}$  in head; eye  $4\frac{2}{3}$ ; maxillary  $2\frac{7}{8}$ ; interorbital space  $3\frac{2}{3}$ ; fourth dorsal spine  $1\frac{7}{8}$ ; second dorsal ray 3; second anal spine  $3\frac{1}{2}$ ; second anal ray  $3\frac{1}{6}$ ; least depth of caudal peduncle  $2\frac{7}{8}$ ; upper caudal lobe  $1\frac{1}{10}$ ; ventral  $1\frac{2}{7}$ ; ventral spine  $1\frac{9}{10}$ ; pectoral 3 in head and trunk. Body deep, strongly compressed, ovate-elliptical, and greatest depth about base of fourth dorsal spine. Head deep, well compressed, high, and upper profile steep, a little concave over orbit. Snout long and deep. Eye a little longer than deep, high. Mouth a little inclined, with rather fleshy lips and upper jaw projecting a little. Maxillary reaching posterior nostril. Incisor teeth very narrow, of almost conical appearance, and molars in 2 rows above. Anterior nostril two-thirds of orbital diameter in front of eye, and posterior an oblique slit midway between. Interorbital space convex. Gill-rakers 6 + 10 short denticles. Scales narrowly imbricated, in series parallel with lateral line above its course, and in horizontal series below. Small scales crowded along bases of rayed dorsal, anal, pectoral and caudal. Scales in 5 rows on cheek. Long axillary ventral flap 2 in fin. Tubes of lateral line simple, which is mostly concurrent with dorsal profile. Spinous dorsal highest anteriorly, origin of first erect spine a little in advance of that of pectoral, and fin not deeply notched. Rayed dorsal inserted a little nearer base of caudal than origin of ventral, and fin low, but slightly elevated anteriorly. Second anal spine longest, third longer than first, and origin of fin nearer that of pectoral than base of caudal. Caudal deeply emarginate, upper lobe a little longer. Pectoral inserted a little behind base of second erect dorsal spine, and reaching base of second anal spine. Ventral inserted a little behind origin of pectoral and not reaching anal. Color brownish, silvered below. Length 11 inches. Stone Harbor.

An abundant food-fish on our shores. Many examples before me from the above locality, Cape May, Anglesea, Grassy Sound, Sea Isle City, Ocean City, Beesley's Point and Atlantic City.

*Stenotomus chrysops* Bean, Bull. U. S. F. Com., 1887, p. 142.—Moore, Bull. U. S. F. Com., XII, 1892, p. 362.—Smith, Bull. U. S. F. Com., XII, 1892, p. 376.

*Pagrus argyrops* Baird, 9th An. Rep. Smiths. Inst., 1854, p 333.

*Stenotomus argyrops* Abbott, Geol. N. J., 1868, p. 809.

*Stenotomus arenosus* Abbott, l. c.

Genus LAGODON Holbrook.

The Sailor's Choice.

**Lagodon rhomboides** (Linnæus).

PLATE 59.

Rhomboidal Porgie.

From the following this differs chiefly in the character of the skull and the deeply notched incisors.

Dr. Abbott first recorded this from Beesley's Point from an example at that time in the collection of the Academy of Natural Sciences of Philadelphia. At present I have been unable to locate the example. It has subsequently been found to be not uncommon at the same locality by Dr. Bean. As it reaches but 6 inches in length it is too small to be of use as a food-fish.

*Lagodon rhomboides* Abbott, Geol. N. J., 1868, p. 809.—Bean, Bull. U. S. F. Com., VII, 1887, p. 142.

Genus ARCHOSARGUS Gill.

The Sheep's Heads.

**Archosargus probatocephalus** (Walbaum).

PLATE 60 (adult), and PLATE 61 (young).

Sheep's Head.

Head  $2\frac{7}{8}$ ; depth  $2\frac{1}{4}$ ; D. XII, 1, 12; A. III, 1, 12; scales about 45 in lateral line to base of caudal and 3 more on latter; about 8 scales obliquely back from origin of spinous dorsal to lateral line; 12 scales between origin of spinous dorsal and lateral line; snout  $3\frac{1}{2}$  in head; eye  $2\frac{4}{5}$ ; maxillary  $3\frac{1}{3}$ ; fifth

dorsal spine  $2\frac{1}{4}$ ; fourth branched dorsal ray nearly 2; second anal spine  $2\frac{1}{3}$ ; sixth branched anal ray  $2\frac{1}{3}$ ; upper caudal lobe 1; least depth of caudal peduncle  $2\frac{1}{3}$ ; pectoral  $1\frac{1}{4}$ ; ventral  $1\frac{1}{3}$ ; ventral spine 2. Body nearly ellipsoid, and back a little elevated. Head deep, upper profile more inclined. Snout steeply convex. Eye circular, anterior. Mouth small, and jaws even. Maxillary reaching a trifle beyond orbit. Scales on body of more or less uniform size, and distributed in rows parallel with lateral line. Scales on head and at base of pectoral very small, numerous and crowded. Lateral line convex and concurrent with dorsal profile. Spinous dorsal inserted a little behind pectoral, graduated from fifth spine which is longest and before it margin of fin deeply notched. Last dorsal spine only about  $\frac{2}{3}$  of first branched ray. Rayed dorsal inserted nearer base of caudal than origin of spinous dorsal, medianly highest, though much shorter posteriorly than anteriorly, and edge of fin convex. Second anal spine longest, third longer than first, edge of fin deeply notched, and origin of first spine just behind base of tenth dorsal spine. Rayed anal inserted a little behind origin of rayed dorsal but similar. Caudal emarginate, lobes rounded. Pectoral long, graduated from third branched ray which is longest, and not quite reaching origin of anal. Ventral inserted opposite origin of spinous dorsal and also not reaching anal. Head dark with a broad predorsal band down to side of throat, and 5 other similar bands on trunk. Of these, first from bases of first 3 dorsal spines down to base of ventral behind pectoral, second from bases of fifth to eight dorsal spines down to middle of post-ventral region, third from bases of tenth to twelfth and first 2 dorsal rays to base of spinous anal, fourth extending between bases of posterior dorsal and anal rays and fifth across side of caudal peduncle posteriorly. A dark shade at base of each caudal lobe. Outer membranes of ventral dark. In life bars are black and interspaces yellowish-green. Length a trifle over  $1\frac{1}{16}$  inches. Beesl y's Point. (From Bean.)

I have no example, though it has been seen at a number of places along our coast, especially at Cape May, Grassy Sound, Stone Harbor, Sea Isle City, Barnegat and Atlantic City. It is a valuable food-fish of excellent flavor and also the object of considerable sport to the angler.



*Archosargus probatocephalus* Bean, Bull. U. S. F. Com., VII, 1887, p. 142, Pl. 3; fig. 10.—Moore, Bull. U. S. F. Com., XII, 1892, p. 362.—Smith, Bull. U. S. F. Com., XII, 1892, p. 374.

*Sargus ovicephalus* Abbott, Geol. N. J., 1868, p. 809.

### Family GERRIDÆ.

#### The Mojarras.

Body oblong or elevated, compressed. Mouth moderate, extremely protractile, descending when protruding. Spines of premaxillary extending to above eye, closing a deep groove on top of head. Maxillary without supplemental bone, not slipping under very narrow preorbital, its surface silvery like rest of head. A slit between base of mandible and preorbital to permit its free motion. Both jaws with slender villiform teeth. No incisors, canines or molars. No teeth on vomer or palatines. Nostrils double, round. Preopercle entire or serrate. Gill-membranes separate, free from isthmus. Gill-rakers short, broad. Pseudo-branchiæ concealed. Branchiostegals 6. Lower pharyngeals close together, often appearing united, teeth blunt. Air-vessel present. Pyloric cœca rudimentary. Vertebrae  $10 + 14 = 24$ . Oviparous. Body covered with large smooth scales. Sides of head scaly. Lateral line continuous, concurrent with back. Dorsal fin single, continuous or deeply notched, spinous and rayed portions about equally developed with scaly sheath along base. Dorsal spines usually IX or X. Anal usually with III spines, soft portion of fin similar to soft dorsal but shorter. Ventrals thoracic, I, 5, rather close together and slightly behind pectorals.

Moderate or small-sized carnivorous fishes in tropical seas, externally very similar in appearance. The larger species are food-fishes of fine flavor. One species has been taken on our shores.

#### Genus EUCINOSTOMUS Baird.

##### The Mojarritas.

##### *Eucinostomus gula* (Cuvier).

Head 4 in total; D. IX, 10; A. III, 7, or 8; P. 13; V. I, 5; eye large, 3 in head. Mouth small, very protractile, and when

protruded presenting a subconicotubular appearance. When retracted posterior extremity of maxillary extends slightly beyond vertical of anterior rim of eye. Lips thin. Palatines and tongue toothless. Opercular apparatus without either spines or serratures. Scales large. Base of spinous dorsal equals that of rayed dorsal. Posterior extremity of soft dorsal rays extending a little more backwards than those of anal fin. Second anal spine not much developed. Ground color silvery with transverse fasciæ of a darker hue in immature examples. Length 3 inches. Great Egg Harbor River and small bays at Beesley's Point. (Baird.)

I have no New Jersey examples. It is a small species reaching a length of 5 inches and occurs on sandy shores.

*Eucinostomus argenteus* Baird and Girard, in Baird, 9th An. Rep. Smiths. Inst., 1854, p. 345.—Abbott, Geol. N. J., 1868, p. 809.

*Gerres argenteus* Bean, Bull. U. S. F. Com., VII, 1887, p. 138.

### Family MULLIDÆ.

#### The Sur Mulletts.

Body elongate, slightly compressed. Upper profile of head more or less parabolic. Mouth small, low, subterminal. Eye moderate, placed high. Two long unbranched barbels at throat, attached just behind symphysis of lower jaw. Teeth mostly small, variously placed. No canines, incisors or molars. Pre-maxillaries somewhat protractile. Maxillaries thin, nearly as broad at base as at tip, without supplemental bone and partly hidden by broad preorbital. Preopercle entire or slightly serrate. Opercle unarmed or with a long spine. Pseudobranchiæ present. Branchiostegals 4. Air-vessel usually present, simple. Pyloric cœca about 20. Vertebrae  $9 + 14 = 23$ . Stomach siphonal. Body covered with large scales, usually slightly ctenoid. Large scales on head. Dorsal fins 2, remote from each other, both short, first of VI to VIII rather high spines depressible in a groove. Anal short, similar to rayed dorsal with I or II small spines. Ventrals thoracic, I, 5.

Fishes of the tropical seas, one species straying to our coast. Many are highly valued as food-fishes.

## Genus MULLUS Linnæus.

## The Sur Mullet.

**Mullus auratus** (Jordan and Gilbert).

PLATE 62.

## Goat Fish. Red Mullet.

Head 3; depth 4; D. VII-I, 8; A. II, 6, 1; snout  $2\frac{1}{2}$  in head; eye 4; maxillary 3; interorbital space  $3\frac{2}{3}$ ; second dorsal spine  $1\frac{7}{8}$ ; pectoral  $1\frac{2}{3}$ ; least depth of caudal peduncle 3. Body elongate, compressed. Profile of head anteriorly above convex. Eye a little elongate, about midway in head. Mouth small, upper jaw protruding a little. Maxillary falling a little short of orbit, and its greatest expansion about half of same. Teeth small, those in upper jaw less conspicuous than mandibular. Vomerine and palatine teeth in large patches, coarse and granular. Interorbital space a trifle convex. Gill-rakers  $3 + 14$ , slender, a little shorter than pupil. Spinous dorsal inserted a little behind origin of ventral. Rayed dorsal inserted a little nearer origin of pectoral than base of caudal, and anteriorly highest. Anal about opposite rayed dorsal. Ventral inserted just behind origin of pectoral. Brownish dull scarlet, crimson where scales have fallen. Length  $3\frac{1}{4}$  inches. I have a single example seined in the surf at Stone Harbor July 12th, 1903. In life it was more or less grayish above, and white beneath washed everywhere with silvery. Along the side an irregular dull and rather dark red band extending to the middle of the base of the caudal. Above and below this several blotches of a similar red color.

This species is known otherwise from within our limits by the accounts of Drs. H. F. Moore and T. H. Bean. It is said to reach a length of 8 inches.

*Mullus surmuletus auratus* Moore, Bull. U. S. F. Com., XII, 1892, p. 362.

*Mullus auratus* Bean, Bull. Am. Mus. N. H., IX, 1897, p. 359.

**Family SCIÆNIDÆ.****The Croakers.**

Body compressed, more or less elongate. Head prominent. Mouth small or large. Teeth in one or more series, outer sometimes enlarged. Canines often present. No incisor or molar teeth. No teeth on vomer, palatines, pterygoids or tongue. Maxillary without supplemental bone, slipping under free edge of preorbital, which is usually broad. Premaxillaries protractile, but not very freely movable. Chin usually with pores, sometimes with barbels. Nostrils double. Preopercle serrate or not. Opercle usually ending in 2 flat points. Gill-membranes separate, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers present. Pseudobranchiæ usually large and present. Branchiostegals 7. Lower pharyngeals separate or united, often enlarged, teeth conic or molar. Air-vessel usually large, complicated, or sometimes wanting. Ear-bones or otoliths very large. Suborbital bones without a backward projecting stay. Pyloric cæca usually rather few. Body covered with rather thin scales, usually more or less ctenoid. Head covered with scales, bones of skull cavernous, muciferous system highly developed, and when flesh is removed surface of skull very uneven. Lateral line continuous, usually more or less concurrent with back and extending on caudal fin. Dorsal fin deeply notched or divided into 2 fins, rayed fin longer and spines depressible into a more or less perfect groove. Anal with I or II spines, never more than II. Caudal usually not forked. Pectorals normal. Ventrals I, 5, thoracic, below or behind pectorals.

Fishes of sandy-shores in all warm seas, some few in fresh-water, but none in deep water or among rocks. They often reach a large size and are valued as food. Their habits are carnivorous, and some are of interest as game fishes. Most species make a peculiar noise, called croaking, drumming, grunting or snoring, which sound is supposed to be caused by forcing air from the air-vessel into one of the lateral horns.

*Key to the genera.*

- a.* OTOLITHINÆ. Vertebrae 14 or 14 + 10 or 11, abdominal portion of spinal column having always more than caudal portion; anal inserted posteriorly; body more or less elongate; mouth large, mandible protruding.  
CYNOSCIION
- aa.* Vertebrae 9 to 12 + 13 to 20, typically 10 + 14, or those in abdominal part always less than caudal portion.
- b.* SCIÆNINÆ. Lower pharyngeals separate.
- c.* No mandibular barbels.
- d.* Teeth well developed, permanent in both jaws.
- e.* Gill-rakers long, slender. BAIRDIELLA
- ee.* Gill-rakers short, thick, usually not longer than posterior nostril. SCIÆNOPS
- dd.* Teeth very small, mandibular wanting or deciduous.  
LEIOSTOMUS
- cc.* Mandible with 1 or more barbels. MENTICIRRHUS.
- bb.* APLODINOTINÆ. Lower pharyngeals very large, completely united, covered with coarse, blunt, paved teeth. POGONIAS

## Genus CYNOSCIION Gill.

## The Weak Fishes.

*Key to the species.*

- b.* Rayed dorsal and anal more or less closely scaled; gill-rakers long, slender, 9 to 12 on lower part of arch. REGALIS
- bb.* Rayed dorsal and anal scaleless; gill-rakers short, thick, 6 to 8 on lower part of arch. NEBULOSUS

*Cynoscion regalis* (Schneider).

## Weak Fish. Squeateague. Blue Fish.

Head  $3\frac{1}{6}$ ; depth  $4\frac{1}{4}$ ; D. X-I, 27, 1; A. II, 11, 1; scales about 55 in lateral line to base of caudal and 7 more on latter; 9 scales between origin of spinous dorsal and lateral line; 10 scales between origin of spinous anal and lateral line in a vertical series; mandible  $1\frac{15}{16}$  in head; second dorsal spine  $2\frac{1}{4}$ ; first dorsal ray  $3\frac{1}{3}$ ; second anal ray  $2\frac{2}{3}$ ; least depth of caudal peduncle  $3\frac{1}{2}$ ; caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{5}{6}$ ; ventral 2. Body long, compressed, of rather fusiform appearance. Head compressed, large, lower profile more inclined than upper, which would form an obtuse angle above middle of length of snout and is then nearly

straight to occiput. Eye a little longer than deep, well anterior. Mouth large, mandible protruding. Maxillary not quite reaching posterior margin of orbit, and its distal expansion  $1\frac{3}{5}$  in length of same. Teeth sharp, in narrow bands, and canines large. Lips a little fleshy. Interorbital space broadly convex. Margin of preopercle thin and with fleshy or cutaneous points. Gill-rakers  $6 + 19$ , compressed, pointed and longest  $1\frac{1}{7}$  in orbit. Scales disposed in oblique series above lateral line to dorsal profile, below more or less horizontal. Small scales crowded along bases of rayed dorsal, anal and caudal, and predorsal region. Lateral line a little high at first, of simple tubes. Spinous dorsal inserted a little nearer tip of mandible than origin of anal, and graduated down from third spine. Rayed dorsal inserted midway between



Weak Fish. *Cynoscion regalis* (Schneider).

middle of orbit and base of caudal, anteriorly elevated. Anal inserted about midway between tip of pectoral and base of caudal, anteriorly elevated. Caudal rounded posteriorly. Pectoral short, a little less than half way to anal. Ventral inserted a trifle before origin of spinous dorsal, not reaching vent, which is close in front of anal. Silvery, darker on back and blotched with darker, some forming undulating lines downward and forward. Dorsals and caudal dusky, ventrals, anals and lower edge of caudal yellowish. Length  $10\frac{1}{8}$  inches. Atlantic City.

Color in life dull brownish above with more or less silvery reflections, burnished especially on back with beautiful shades of pale or light purple, lavender, greenish, bluish, coppery and brassy with more or less metallic luster. Markings on back ex-

tending down to middle of side pale olivaceous. Along side of head and just below pectoral a tinge of azure. Head above, including upper jaw and maxillary distally, the line of demarcation crossing broadly posteriorly, brownish. Tips of jaws dusky. Dorsal, anal and caudal translucent or pale olivaceous, rays darker. Lower margin of caudal at rudimentary rays tinted yellowish-green. Pectoral tinted with olivaceous and small dots, and lower radii whitish. Ventral and anal tinted with bright gamboge. Lower surface of body opaque milky or chalky-white. Iris pearly brownish-white. Axil of pectoral white, flap inside above dusky olive. Inside of gill-opening whitish sprinkled with dusky. Spinous dorsal dusky-olive. These colors from a half-grown example taken at Barnegat Pier July 18th, 1905.

A common and highly valued food-fish of rich delicate flesh. It is abundant on the sandy-shores. My examples from Cape May, Holly Beach, Wild Wood, Anglesea, Grassy Sound, Stone Harbor, Sea Isle City, Beach Haven, Ocean City, and Beesley's Point.

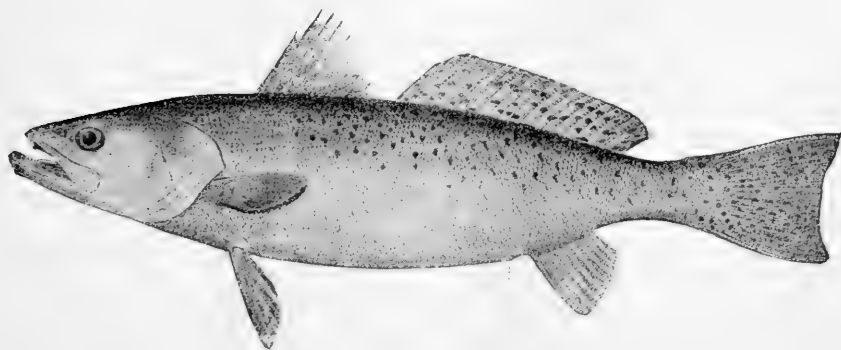
*Otolithus regalis* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 329.

*Cynoscion regalis* Abbott, Geol. N. J., 1868, p. 810.—Verrill, Am. Nat., V., 1871, p. 398.—Moore, Bull. U. S. F. Com., XII, 1892, p. 363.—Smith, Bull. U. S. F. Com., XII, 1892, p. 376.

*Cynoscion regale* Bean, Bull. U. S. F. Com., VII, 1887, p. 140, Pl. 2, fig. 6.

***Cynoscion nebulosus* (Cuvier).**

Spotted Weak Fish.



Southern Weak Fish. *Cynoscion nebulosus* (Cuvier).

Distinguished from the preceding by the scaleless soft dorsal and anal.

Rare and casual on our coast. An excellent food-fish closely resembling the preceding. It occurs sometimes at Sea Isle City and Cape May.

*Cynoscion nebulosus* Smith, Bull. U. S. F. Com., XII, 1892, p. 377.—Jordan and Evermann, Bull. U. S. Nat. Mus. No. XLVII, II, 1898, p. 1409.

*Cynoscion carolinensis* Abbott, Geol. N. J., 1868, p. 810.

*Cynoscion maculatus* Bean, Bull. U. S. F. Com., VII, 1887, p. 140.

### Genus BAIRDIELLA Gill.

#### The Mademoiselles.

#### **Bairdiella chrysura** (Lacépède).

PLATE 63.

#### Silver Perch.

Head  $2\frac{4}{5}$ ; depth  $3\frac{1}{8}$ ; D. X, I, 21; A. II, 10; scales about 58 in lateral line to base of caudal with several more on latter; about 6 scales from origin of spinous dorsal obliquely back to lateral line; 12 scales in a vertical series between lateral line and origin of anal; snout 4 in head, measured from tip of upper jaw; eye  $3\frac{1}{4}$ ; maxillary 2; third dorsal spine 2; third dorsal ray  $2\frac{1}{2}$ ; second anal spine  $2\frac{1}{2}$ ; second anal ray 2; caudal  $1\frac{1}{6}$ ; pectoral  $1\frac{3}{8}$ ; ventral  $1\frac{3}{4}$ ; ventral spine  $3\frac{1}{4}$ . Body ovate-elongate, profiles similar. Head large, upper profile a trifle concave over eye. Snout convex and short. Eye circular, anterior. Mouth large, mandible apparently projecting. Maxillary long, nearly to posterior border of pupil. Head scaly, and scales on side large. Scales on costal region also large. Small scales crowded on bases of rayed dorsal, anal and caudal. Spinous dorsal inserted a little behind origin of pectoral and graduated from subequal third and fourth spines which are longest. Rayed dorsal begins before anal or its origin falling a trifle nearer base of caudal than posterior margin of pupil, and fin of more or less



uniform height from third ray. Anal begins nearly midway between base of caudal and origin of pectoral, second spine elongate. Rayed anal highest anteriorly, so that last ray is less than half height of first. Posterior margin of caudal well rounded convexly. Pectoral short, about  $\frac{5}{8}$  of space to anal. Ventral inserted a trifle behind pectoral and before spinous dorsal. A trifle over 1 inch long. Beesley's Point. (From Bean.)

I have no examples. It is said to be abundant at Beesley's Point. According to Baird the young have no markings of any kind, the sides being of a uniform yellowish-white. It reaches but a small size and therefore has no great economic value. It is a fine pan-fish of good flavor.

*Bairdiella chrysura* Bean, Bull. U. S. F. Com., VII, 1887, p. 141, Pl. 1, fig. 9.—Moore, Bull. U. S. F. Com., XII, 1892, p. 362.

*Corvina argyroleuca* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 331.

*Bairdiella punctata* Abbott, Geol. N. J., 1868, p. 810.

#### Genus SCIÆNOPS Gill.

#### The Red Drums.

#### *Sciænops ocellatus* (Linnæus).

PLATE 64.

#### Red Fish. Red. Drum. Channel Bass.

It differs from the preceding in the short thick gill-rakers, usually not longer than posterior nostril.

A very common fish on our southern coast, especially about Cape May and in Delaware Bay. As a food-fish it is important, reaching a length of 5 feet and a weight of 75 pounds.

*Scianops ocellatus* Abbott, Geol. N. J., 1868, p. 810.—Bean, Bull. Am. Mus. N. H., IX, 1897, p. 367.

*Sciana ocellata* Smith, Bull. U. S. F. Com., XII, 1892, p. 377.

Genus *LEIOSTOMUS* Lacépède.

## The Goodies.

*Leiostomus xanthurus* Lacépède.

## PLATE 65.

Spot. Cape May Goody. Goody. Porgy.

Head  $3\frac{1}{5}$ ; depth  $2\frac{4}{7}$ ; D. X-I, 31, 1; A. II, 12, 1; scales 50 in lateral line to base of caudal, and 4 more in latter; 12 scales between origin of spinous dorsal and lateral line; 14 scales in a vertical series between origin of spinous anal and lateral line; snout  $3\frac{1}{8}$  in head; eye 4; maxillary  $2\frac{7}{8}$ ; interorbital space  $3\frac{3}{5}$ ; fourth dorsal spine  $1\frac{3}{5}$ ; third dorsal ray  $2\frac{2}{5}$ ; second anal spine  $4\frac{1}{8}$ ; second anal ray 2; least depth of caudal peduncle  $2\frac{5}{8}$ ; upper caudal lobe 1; pectoral  $1\frac{1}{6}$ ; ventral  $1\frac{3}{7}$ . Body short, deep, much compressed, ovate-elliptical, and predorsal region trenchant. Back elevated. Head obtuse, profile above steep, convex and depressed a little over eye. Snout short, obtuse, projecting beyond upper jaw. Eye circular, high and anterior. Mouth small, horizontal, inferior. Maxillary extending to middle of orbit. Lips a little fleshy. A band of feeble teeth in upper jaw, lower obsolete or absent. Nostrils separated, in front of eye. Interorbital space a little convex. Preopercle entire. Gill-rakers  $10 + 23$ , lanceolate, short, longest about  $\frac{3}{4}$  of pupil. Scales small on predorsal region, bases of rayed dorsal, anal and caudal. Body scales disposed in oblique series not parallel with curve of lateral line. Tubes of lateral line a little branched. Origin of spinous dorsal just behind that of pectoral, and anterior spines highest. Origin of rayed dorsal about midway between posterior nostril and base of caudal, and a little higher anteriorly. Origin of anal a little nearer base of caudal than origin of pectoral, second spine about  $\frac{3}{7}$  length of first ray, which is longest. Caudal slightly emarginate, and upper lobe produced a little beyond lower. Pectoral  $1\frac{1}{2}$  in space to anal. Ventral inserted a little behind origin of pectoral, and reaching  $1\frac{1}{2}$  in space to anal. Color dull bluish on back, below silvery. On back 16 narrow

brownish-dusky wavy lines obliquely forward from dorsal profile below lateral line. A blackish humeral blotch smaller than orbit. Fins dull olive. Length 7 inches. Atlantic City.

Abundant on our coast, and on account of its small size is valued chiefly as a pan-fish of excellent flavor. They are frequently angled for about wharves, and often form a large percentage of the catch of the visiting fisherman to the seashore resorts. They are often eagerly landed by youthful anglers, together with *Tautoglabrus adspersus* and small examples of *Centropristes striatus*.

*Liostomus xanthurus* Abbott, Geol. N. J., 1868, p. 811.—Bean, Bull. U. S. F. Com., VII, 1887, p. 141.

*Leiostomus xanthurus* Moore, Bull. U. S. F. Com., XII, 1892, p. 362.—Smith, Bull. U. S. F. Com., XII, 1892, p. 377.

*Leiostomus obliquus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 329.

*Liostomus obliquus* Abbott, l. c.

## Genus MENTICIRRHUS Gill.

### The King Fishes.

#### Key to the species.

- a. Outer upper teeth enlarged; dorsal spines little elevated; color silvery-gray with obscure dark markings. AMERICANUS
- aa. Outer upper teeth less enlarged; dorsal spines elevated; color scarcely silvery. SAXATILIS

#### *Menticirrhus americanus* (Linnæus).

PLATE 66.

#### King Fish.

D. X, I, 23; A. I, 7. Longest dorsal spine one-half as long as soft dorsal, and two-thirds length of head. Length 12 inches. Great Egg Harbor Bay. (Bean.)

Distinguished from the next by the enlarged teeth in the outer series of the upper jaw, longest dorsal spine not reaching front

of soft dorsal, and coloration with dark markings often obsolete.

Known from Dr. Bean's record of 2 examples taken in the Great Egg Harbor Bay.

*Menticirrhus alburnus* Bean, Bull. U. S. F. Com., VII, 1887, p. 141.

***Menticirrhus saxatilis* (Schneider).**

PLATE 67.

King Fish. Hake. Barb.

Head  $3\frac{2}{5}$ ; depth 4; D. IX-I, 24, 1; A. I, 8; scales 53 in lateral line to base of caudal and 5 more on latter; 8 scales in vertical series between origin of spinous dorsal and lateral line; 13 scales in a vertical series between origin of anal and lateral line; snout  $3\frac{1}{5}$  in head; eye  $6\frac{1}{4}$ ; maxillary  $2\frac{5}{6}$ ; interorbital space  $3\frac{2}{3}$ ; third dorsal spine  $1\frac{3}{7}$ ; third anal ray  $2\frac{3}{5}$ ; least depth of caudal peduncle 3; pectoral  $1\frac{1}{4}$ ; ventral  $1\frac{3}{4}$ . Body elongate, well compressed, back well elevated with convex profile so that greatest depth falls about middle of base of spinous dorsal. Head obtusely conic in front, narrowed somewhat above, broader below, and upper profile evenly though slightly convex from tip of snout to origin of spinous dorsal, very slightly depressed over eyes. Snout bluntly convex and projecting beyond tip of upper jaw. Eye a little elongate, high and well anterior. Mouth horizontal, anterior, and with rather narrow fleshy lips, papillose inside. Maxillary reaching opposite posterior margin of pupil. Teeth fine, in bands in jaws, outer series of upper a little enlarged. A single short thick fleshy barbel at symphysis of mandible below. Interorbital space rather broad and a little convex. Anterior nostril a little posterior in snout, and posterior higher, much larger and obliquely oval. Opercular spines weak, short. Margin of preopercle thin, with slight denticles. Gill-rakers iv + iv short rounded fleshy tubercles. Scales rather large, narrowly imbricated, finely ctenoid, becoming noticeably smaller and crowded on base of rayed dorsal, caudal and pectoral. Head scaled, except jaws, lower surface of snout and head, and maxillary. Lateral line of arborescent tubes and concurrent with dorsal profile. Spinous dorsal elevated anteriorly, inserted a little nearer origin of anal than tip of snout or a little behind that of pectoral. Rayed

dorsal inserted a little nearer tip of snout than base of caudal. Anal inserted behind origin of rayed dorsal, or about midway between posterior margin of preopercle and base of caudal, spine rather flexible, and middle of fin highest. Caudal rather broad. Pectoral  $\frac{5}{7}$  to anal. Ventral inserted behind base of third dorsal spine and reaching  $\frac{5}{8}$  to anal. Vent about  $\frac{3}{4}$  an eye-diameter in advance of anal. Dusky-gray, with oblique cross-bands of darker extending downward and forward. Anterior band at nape extends to meet second band so as to form a V-shaped blotch on each side. Dorsals, caudal and pectorals pale dusky, upper part of spinous dorsal deeper. Length a little over a foot. Beesley's Point.

Color of young in life a beautiful plumbeous above tinted with brownish and offset with fine greenish, purplish and bluish metallic reflections. Markings on back of darker or deeper brownish than body-color, and in some lights tinted with a little lavender. Fins dull translucent brownish, spinous fins with blackish-brown shades and soft dorsal and caudal with duller brownish. Paler markings on fins tinted with dull milky, dorsal spines burnished with greenish and bluish. Pectoral, ventral and anal edged with whitish, also radii of latter and first ray to each ventral. Greater distal portion of pectoral dusky with rest of fin of dull brassy-brown, base of pale. Ventral with body of fin of brassy-brown tint, rays more or less whitish, and membranes specked or dotted with deep dusky or blackish. Anal similar and somewhat creamy. Lower surface milky-white, specked or soiled a little with brownish laterally. Sides of head and body with bluish and purplish tints. Lips translucent. Iris warm brownish. Inside of gill-opening gilded brownish and dusky. Ocean City.

An abundant food-fish of excellent quality on sandy-bottoms. My examples from Cape May, Anglesea, Stone Harbor, Sea Isle City, Ocean City, and Atlantic City. The young were found abundantly in the surf at Stone Harbor, Cape May and Ocean City, associated with *Trachinotus carolinus*, *Menidia menidia notata* and other small fishes.

*Menticirrhus saxatilis* Bean, Bull. U. S. F. Com., VII, 1887, p. 141, Pl. 2-3, figs. 7-8.

*Menticirrhus saxatilis* Moore, Bull. U. S. F. Com., XII, 1892, p. 362.—Smith, Bull. U. S. F. Com., XII, 1892, p. 377.

*Umbrina alburnus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 331.

*Mentiarthus nebulosus* Abbott, Geol. N. J., 1868, p. 810.

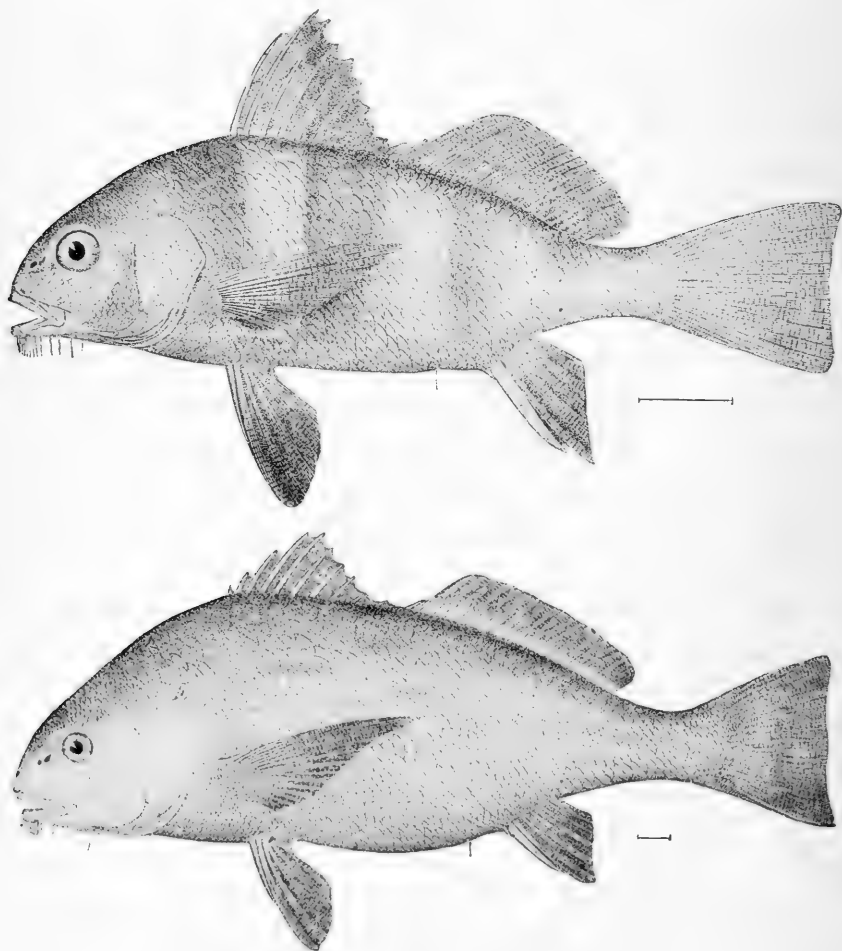
*Umbrina regalis* Verrill, Am. Nat., V, 1871, p. 398.

Genus *POGONIAS* Lacépède.

The Sea Drums.

*Pogonias cromis* (Linnæus).

Big Drum. Banded Drum. Gray Drum. Black Drum. Drum Fish.



Black Drum, *Pogonias cromis* (Linnæus).  
(Upper figure young, lower adult.)

Sides yellowish-silvery with 6 or 7 broad dark vertical bars between head and tail. Dorsal and caudal dusky towards their borders, and spinous dorsal quite dark. Pectoral colorless. Ventral and anal yellow. Beesley's Point. (Baird.)

As our only representative of the croakers with large pharyngeals below completely united and covered with coarse blunt paved teeth (*Aploclinotina*) this fish is easily distinguished.

As a food-fish it is rather coarse, and the flesh is of no great value. They reach a large size and weigh as much as 146 pounds. Large examples were found at Stone Harbor.

*Pogonias chromis* Abbott, Geol. N. J., 1868, p. 811.—Bean, Bull. U. S. F. Com., VII, 1887, p. 141.

*Pogonias cromis* Moore, Bull. U. S. F. Com., XII, 1892, p. 362.—Smith, Bull. U. S. F. Com., XII, 1892, p. 378.

*Pogonias fasciatus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 332.—Abbott, l. c.

### Family LATILIDÆ.

#### The Blanquillos.

Body more or less elongate, fusiform or compressed. Head subconical, anterior profile usually convex. Mouth rather terminal, little oblique. Teeth rather strong. No teeth on vomer or palatines. Premaxillary usually with a blunt posterior canine, somewhat as in *Labridæ*. Premaxillaries protractile. Maxillary without supplemental bone, not slipping under edge of preorbital. Suborbital without bony stay. Bones not greatly developed. Cranial bones not cavernous. Opercular bones mostly unarmed. Vertebrae in normal or slightly increased number (24 to 30). Gill-membranes separate, or more or less united, often adherent to isthmus. Gills 4, a long slit behind fourth. Pseudobranchiae well developed. Lower pharyngeals separate. Pyloric cæca few or none. Scales small, ctenoid. Lateral line present, complete, more or less concurrent with back. Dorsal fin long and low, usually continuous, spinous portion always much less developed than soft portion, but never obsolete. Anal fin very long, its spines feeble and few. Caudal fin forked, tail deeply diphyccercal.

Pectorals not very broad, rays all branched. Ventrals thoracic or subjugular, I, 5, close together.

Fishes of the tropical and temperate seas, some reaching a large size.

Genus *LOPHOLATILUS* Goode and Bean.

The Tile Fishes.

*Lopholatilus chamæleonticeps* Goode and Bean.

PLATE 68.

Tile Fish.

Head  $3\frac{1}{8}$ ; depth  $3\frac{3}{5}$ ; D. VII, 15; A. II, 13; scales about 88 in lateral series to base of caudal, and about 8 more on latter; pores about 70 in lateral line to base of caudal and 6 more on latter; 8 scales between lateral line and dorsal at origin, and 25 between lateral line and origin of anal, in vertical counts; snout  $2\frac{1}{3}$  in head; eye  $5\frac{1}{3}$ ; maxillary  $2\frac{2}{5}$ ; interorbital space  $3\frac{2}{3}$ ; seventh dorsal spine  $3\frac{1}{5}$ ; thirteenth dorsal ray 2; second anal spine  $3\frac{2}{5}$ ; twelfth anal ray  $2\frac{4}{7}$ ; upper caudal lobe  $1\frac{2}{5}$ ; pectoral  $1\frac{3}{10}$ ; ventral  $1\frac{3}{5}$ ; least depth of caudal peduncle  $3\frac{1}{3}$ ; greatest width of body a little more than caudal peduncle; 20 maxillary canines, and irregular; about 14 mandibular canines; mandibular barbel about  $2\frac{1}{2}$  in eye; space between posterior nostril and eye a trifle more than first anal spine, and less than one-third space to tip of snout; inner caudal rays  $1\frac{2}{7}$  in outer rays; vent behind fourth dorsal ray. Upper profile of head convex. Head deep, well compressed and sides flattened. Gill-rakers 9 + 13, short, and inner surface asperous. Gill-filaments short, though longer than rakers, or one-third of orbit. Last dorsal and anal ray produced. Pectoral reaches anal, seventh ray longest, and eighth ray  $1\frac{4}{7}$  in length of former. Ventral spine about  $\frac{4}{7}$  length of fin. Ventral inserted a trifle behind pectoral and not reaching vent. Margin of spinous dorsal notched and first two spines close together. Lateral line high and straight below bases of dorsal. Length 23 inches. The example described



above was taken in August, 1903, by Capt. Robert Johnson, of the schooner O. Teal, in Lat.  $40^{\circ} 7'$  North and Long.  $69^{\circ} 34' 30''$  W., in 600 fathoms of water.

Color when fresh plumbeous-olive above, each scale on front of back with a more or less dark lemon-yellow base. Middle of side of head and trunk pale, inclining to whitish of lower surface. Back posteriorly, especially on upper surface of caudal peduncle, with deep plumbeous-purple tinge. Lower surface of head and trunk white, more or less tinged with dilute lemon-yellow below, especially in front of ventrals and on gular region. Back, upper side, and posterior side of head marked with numerous round lemon-green spots, smaller anteriorly, especially on cheek, and becoming larger posteriorly on caudal peduncle above. Mandible white. Adipose fin dark lemon-green, its base largely dusky-lemon-green, and margins dusky. Dorsal pearl-grayish, each spine and ray with a large median portion lemon-green, but little of which extends on membranes. Upper portion of spinous dorsal slaty, top of each spine pearly. Upper two-thirds of soft dorsal slaty, fading lighter above till margin is diffuse pearly. Anal pearl-gray with a large chalky-white blotch basally between each ray, and posterior marginal portion of fin with pale cinerous tints. Pectoral plumbeous, becoming pearl-gray basally and below, and a bright lemon-olive ocellus edged with black at base of fin above. Inside basal portion of fin tinged with bright olive-yellow or greenish on each dark ray. Ventral pearl-gray, a little pale plumbeous distally, and spine lemon-yellow. Caudal like back, lower margin pearl-gray, and posterior marginal portion becoming dark slaty. Caudal also marked with large vertical lemon-green blotches more or less confluent. Iris a most beautiful iridescent-green, blue and purple like inside of *Halotis*.

"In Forest and Stream" for 1883 is an account of this fish from between the Grand Banks and Barnegat. This was noticed in the same year by the American Naturalist, Vol. XVII, p. 91. They were unknown to the fishermen, and were strewn upon the surface of the seas in a belt 30 to 50 miles wide, and so thickly that it was estimated that fully 50 lay in the area of a bark's cabin. When first reported they were in good condi-

tion and proved excellent food. The cause of mortality was unknown, but Professor Baird was of the opinion that concussion caused by terrific storms, which raged off the banks, might probably account for it.

### Sub-Order PHARYNGOGNATHI.

#### The Labroid Fishes.

Tropical fishes, mostly large, with bright colors and strong dentition.

#### *Key to the families.*

- a. Lower pharyngeals T-shaped or Y-shaped, their teeth conical or tubercular; teeth usually not confluent; carnivorous, and sexes often dissimilar. LABRIDÆ
- aa. Lower pharyngeals spatulate or basin-shaped, their teeth broadest transversely and truncate, arranged in mosaic; teeth in jaws more or less perfectly confluent, forming a sort of beak; herbivorous, and sexes colored alike. SCARIDÆ

### Family LABRIDÆ.

#### The Wrasse Fishes.

Body oblong or elongate. Mouth moderate, terminal. Pre-maxillaries protractile. Maxillaries without supplemental bone, slipping under membranaceous edge of preorbital. Anterior teeth in jaws usually very strong and canine-teeth. Teeth of jaws separate or soldered together at base, not forming a continuous plate. No teeth on vomer or palatines. Lips thick, longitudinally plicate. Nostrils round, with 2 openings on each side. Gill-membranes somewhat connected, sometimes joined to narrow isthmus. Gills  $3\frac{1}{2}$ , a slit behind last arch small or obsolete. Pseudobranchiæ well developed. Branchiostegals 5 or 6. Lower pharyngeals completely united into 1 bone, without median suture, this bone T-shaped or Y-shaped, its teeth conical or tubercular. Air-vessel present. No pyloric cæca. Body covered with cycloid scales. Lateral line well developed, continuous or interrupted, often angularly bent. Dorsal fin continuous, spinous

portion usually long, its spines rather slender, III to XX in number. Anal similar to soft dorsal, with II to VI spines. Ventrals thoracic, I, 5, inserted below pectorals, which are sometimes subthoracic.

Fishes of the tropical seas, living among rocks or kelp. Many are brilliantly colored, and some are valued as food. Most feed upon mollusks, the dentition being adapted for crushing shells. Two species on our shores.

*Key to the genera.*

- a.* Preopercle serrate; opercles scaly; muzzle a little pointed. TAUTOGOLABRUS  
*aa.* Preopercle entire; opercles naked; muzzle a little blunt. TAUTOGA

Genus TAUTOGOLABRUS Günther.

The Cunners.

**Tautogolabrus adspersus** (Walbaum).

PLATE 69.

Bengal. Gall. Bergall. Nibbler. Conner.

Head  $3\frac{1}{6}$ ; depth  $3\frac{1}{4}$ ; D. XVIII, 10; A. III, 9; scales 36 in lateral line to base of caudal and 4 more on latter; 6 scales obliquely back from base of third dorsal spine; 13 scales in a vertical series between origin of spinous anal and lateral line; snout  $3\frac{1}{10}$  in head; eye  $4\frac{2}{3}$ ; maxillary  $4\frac{1}{5}$ ; interorbital space  $3\frac{2}{3}$ ; seventeenth dorsal spine  $2\frac{3}{4}$ ; fourth dorsal ray  $2\frac{1}{10}$ ; third anal spine  $2\frac{3}{5}$ ; fifth anal ray 2; caudal  $1\frac{3}{7}$ ; least depth of caudal peduncle 2; pectoral  $1\frac{3}{5}$ ; ventral  $1\frac{2}{3}$ . Body elongate, rather slender, robust, compressed. Head rather large, nearly as deep as long, with conic profile. Snout conic. Eye high, anterior, and a little elongate. Jaws not notably produced, even. Mouth oblique. Maxillary not quite reaching eye. Teeth unequal, conic, pointed, and no posterior canines. In front of upper jaw 4 canines, and same number in lower. Lateral teeth enlarging anteriorly. Bands of small concave teeth behind canines. Lips thick and fleshy. Interorbital space convex. Margin of pre-

opercle finely serrated. Gill-rakers 5 + 10, short and spinous. Scales rather small, smaller still on predorsal region and base of caudal. Opercle scaly, and 4 rows on cheek, and head with these exceptions naked. Fins naked, except base of caudal. Lateral line interrupted at caudal peduncle. Dorsal long, low, spinous portion much longer than rayed, margin notched, a little higher posteriorly, and inserted a trifle behind origin of pectoral. Rayed dorsal rounded, and inserted a little nearer base of caudal than tip of depressed pectoral. Spinous anal inserted about midway between origin of pectoral and base of caudal, graduated to third spine, which is longest, second subequal. Rayed anal similar to rayed dorsal. Caudal with convex posterior margin. Pectoral broad, rounded, a little over half way to origin of anal. Ventral inserted a little behind origin of pectoral, about  $\frac{2}{3}$  of space to anal. Color in life livid bluish, shaded dusky above. Length  $6\frac{1}{4}$  inches. Anglesea.

Abundant along our coast, and a pest to wharf-fishermen, as it nibbles the bait off the hook. They are useful as scavengers, however, and though of too small size as food-fish, reaching a length of but 10 inches, are of fine flavor. It prefers the vicinity of wharves, rocks or abrupt banks. My examples from Grassy Sound and Barnegat Pier.

*Tautogolabrus adspersus* Abbott, Geol. N. J., 1868, p. 809.

*Ctenolabrus adspersus* Bean, Bull. U. S. F. Com., VII, 1887, p. 137.—Smith, Bull. U. S. Fish Com., XII, 1892, p. 378.

*Ctenolabrus caruleus* Baird, Icon. Encycl. Sci. Lit. Art., II, 1851, p. 218.

### Genus TAUTOGA Mitchill.

#### The Black Fishes.

#### **Tautoga onitis** (Linnæus).

#### PLATE 70.

Black Fish. Tautoga. Tautog. Smooth Black Fish. Chub.  
Sea Tog.

Head 3; depth  $3\frac{1}{2}$ ; D. XVII, 10, 1; A. III, 10, 1; scales 60 in lateral line to base of caudal and 6 more on latter; snout 3 in

head; eye  $5\frac{3}{4}$ ; maxillary  $3\frac{3}{4}$ ; interorbital space  $3\frac{1}{2}$ ; sixth dorsal spine  $3\frac{1}{4}$ ; sixth dorsal ray 2; third anal spine  $2\frac{2}{3}$ ; fourth anal ray 2; least depth of caudal peduncle  $1\frac{2}{3}$ ; caudal  $1\frac{1}{3}$ ; pectoral  $1\frac{2}{3}$ ; ventral  $1\frac{2}{3}$ . Body long, somewhat deep and compressed. Profile moderately steep, well rounded from snout to dorsal. Head large, profile convex and nearly as deep as long. Snout a little long, convex. Eye small, high up, circular. Mouth rather small. Teeth strong, conic, biserial, outer series somewhat incisor-like, 2 anterior in each jaw strong, and posterior small, without canines. Jaws equal. Lips thick and fleshy. Interorbital space convex. Gill-rakers  $4 + 9$ , short, blunt. Scales small, minute on belly, breast, predorsal region, and base of caudal. On cheek a series of 7 small scales, and rest of head, except patch behind eye, naked. Lateral line abruptly decurved below end of rayed dorsal. Dorsal long, low, continuous, spinous part much larger, of more or less uniform height, margin notched, behind tip of each spine a cutaneous point, and its origin about opposite that of pectoral. Rayed dorsal rounded, inserted much nearer tip of pectoral than base of caudal. Anal inserted a little anterior, about midway between origin of dorsal and base of caudal, spines graduated to third which is longest, and margin of fin deeply notched with a filament behind tip of first and second spines. Rayed anal long and rather low. Caudal broad and rounded. Pectoral broad, rounded, about  $\frac{5}{8}$  of space to anal. Ventral inserted about opposite first third of pectoral, and nearly  $\frac{3}{5}$  to anal. Ventral spine about  $\frac{4}{7}$  length of fin.

General color when fresh mouse-gray, under surface but slightly paler, edges of scales but little darker, and vertical streaks or reticulations blackish-slate. Side of body posteriorly a little pale, though markings very pronounced and in contrast, producing a beautiful variegated appearance. Head laterally with a little brownish tinge, soiled whitish on under surface. Lips pale brownish, lower paler. Iris with an outer circle of greenish encircling bright golden one, which in turn encircles pupil. Dorsals, caudal, anal and ventral brownish-gray, margins of soft dorsal, caudal and anal a little paler or more brownish, though all of these fins variegated with dull blackish-slate. Ventral spine pale or whitish, also rest of fin anteriorly and basally. Pec-

toral translucent brownish with a glazed gilded effect. Inside of gill-opening pale or translucent-whitish. Length  $8\frac{1}{8}$  inches. Sea Isle City. September 2d, 1905.

A fine food-fish reaching a length of 3 feet and generally abundant on our coast in shallow water and about kelp. My examples from Stone Harbor, Atlantic City, Cape May and Beesley's Point.

*Tautoga onitis* Abbott, Geol. N. J., 1868, p. 809.—Bean, Bull. U. S. F. Com., VII, 1887, p. 137, Pl. 3, fig. 3.—Moore, Bull. U. S. F. Com., XII, 1892, p. 363.—Smith, Bull. U. S. F. Com., XII, 1892, p. 378.

*Labrus tautoga* Mitchill, Tr. Am. Philos. Soc. Phila., 1815, p. 399.

*Tautoga americana* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 340.

### Family SCARIDÆ.

#### The Parrot Fishes.

Body oblong, moderately compressed. Mouth moderate, terminal. Teeth in jaws more or less coalescent, at least base. Lower pharyngeals much enlarged, united in a concave or spoon-shaped body, their teeth broadest transversely and truncate, arranged in mosaic. Vertebrae about  $11 + 14 = 25$ . Squamation varying little except on head. Body covered with large cycloid scales, as in the *Labridæ*. About 23 to 25 scales in lateral line. Dorsal continuous, its formula usually IX, 10, and anal II, 9. Fin rays essentially same throughout. Sexes similarly colored, and coloration almost always brilliant. Herbivorous fishes often of large size, not valued as food, the flesh being soft and pasty. One species straggling to our shores.

Genus SPARISOMA Swainson.

Viejas.

*Sparisoma* sp.

Scales  $2\frac{1}{2}$ –24–6. Teeth ankylosed, but with free conical tips in both jaws. Gill-membranes attached to isthmus. Color after

immersion in alcohol over night greenish-olive, except abdomen and under surface of head, which are whitish washed with yellow. A broad light brown stripe on tip of lower jaw. Two similar stripes on cheek, one extending from below eye downward and forward. A pale band along median line, and another on lateral line. Dorsal, anal and pectoral fins pink, speckled with brown cross-bands. Length  $2\frac{1}{10}$  inches. Seined September 5th, 1887, near the mouth of Lousy Harbor, Somers Point. (Bean.)

Only known from the above account by Dr. Bean.

*Sparisoma* sp. Bean, Bull. U. S. F. Com., VII, 1887, p. 137.

### Sub-Order SQUAMIPENNES.

#### The Scaly Fins.

A large group showing affinities with scombroid forms on one side and percoid on another, the typical form specialized toward the *Plectognathi*.

#### *Key to the families.*

- a. Dorsal fins 2; separate teeth slender, hardly brush-like. ILARCHIDÆ
- aa. Dorsal continuous.
  - b. Teeth brush-like, setiform, thick-set; carnivorous; caudal peduncle unarmed; scales well developed. CHÆTODONTIDÆ
  - bb. Teeth incisor-like, uniserial; herbivorous; caudal peduncle usually armed with spines or tubercles; scales minute, rough. HARPURIDÆ

### Family ILARCHIDÆ.

#### The Spade Fishes.

Body compressed, usually greatly elevated, anterior profile steep, and caudal peduncle short. Mouth small, terminal, horizontal. Premaxillaries slightly protractile. Maxillary short, without supplemental bone, partly slipping under narrow pre-orbital. Jaws with bands of slender pointed movable brush-like teeth. Nostrils double. Preopercle very finely serrated or entire. Post-temporal bifurcate as usual among fishes, not joined to skull. Gill-membranes broadly attached to isthmus, openings restricted to sides. Gill-rakers very short. Pseudobranchiæ present.

Branchiostegals 6 or 7. Air-vessel large, commonly bifurcate in front and with 2 slender horns behind. Pyloric cœca few. Vertebrae  $10 + 14 = 24$ . Scales moderate, or small, ctenoid, densely covering soft parts of vertical fins. A large accessory scale in *Sparidæ*. Lateral line present, following curve of back. Dorsal fins 2, somewhat connected, first of VII to XI spines, which are depressible in a groove. Soft dorsal and anal anteriorly high, their bases thickened by scales. Anal spines III or IV, short. Caudal truncate or doubly concave. Pectorals short, rays all branched. Ventrals thoracic, normally I, 5, sometimes rudimentary.

Shore-fishes mostly of large size in warm seas, and often valued as food.

### Genus CHÆTODIPTERUS Lacépède.

#### The Spade Fishes.

#### *Chætodipterus faber* (Broussonet).

#### PLATE 71.

#### Angel Fish.

Head  $3\frac{1}{2}$ ; depth  $1\frac{1}{2}$ ; D. IX, 23; A. III, 18; 52 tubes in lateral line; 12 scales between origin of spinous dorsal and lateral line; 30 scales in a vertical series between origin of rayed anal and lateral line; snout  $2\frac{1}{2}$  in head; eye  $4\frac{2}{5}$ ; interorbital space  $2\frac{3}{7}$ ; maxillary  $3\frac{1}{6}$ ; second dorsal spine  $1\frac{2}{3}$ ; least depth of caudal peduncle 2; upper caudal lobe 1; pectoral  $1\frac{2}{3}$ ; ventral 1; longest dorsal ray 2 in head and trunk; longest anal ray 3. Body deep, much compressed, elevated, nearly orbicular, and anterior profile nearly vertical. Head deep, compressed. Snout robust, convex. Eye circular, high, anterior. Jaws heavy, upper protruding a little. Lips thick and fleshy. Teeth in jaws slender, somewhat movable. Nostrils separated widely, anterior circular and inferior, posterior slit-like, close before front of eye. Interorbital space convexly swollen. Preopercle finely serrate. Preorbital nearly as wide as eye. Gill-rakers  $5 + 12$ , little elongate, thick. Scales small, crowded, minute and very numerous on



head and fins. Tubes of lateral line simple, large. Ventral with scaly axillary flap. Third dorsal spine slender, much longer than others. Rayed dorsal inserted about midway between posterior edge of orbit and base of caudal, and anteriorly with a long slender falcate lobe. Anal spines small, graduated to last, which is longest. Rayed anal similar to rayed dorsal, and its insertion falling nearer base of caudal than origin of pectoral. Caudal deeply lunate, lobes not distinct, pointed. Pectoral short, half way to rayed anal, and placed below eye. Ventral long, pointed, a little over  $\frac{2}{3}$  of rayed anal. Grayish with metallic reflections. Ventral dusky. Length  $14\frac{1}{4}$  inches. Anglesea.

The above example was secured by Mr. Wm. J. Fox in July, 1903. Mr. Fox also observed it at Sea Isle City during the early summer of 1905. An excellent food-fish reaching a length of 3 feet.

*Ephippus faber* Abbott, Geol. N. J., 1868, p. 811.

*Ephippus gigas* Abbott, l. c.

### Family CHÆTODONTIDÆ.

#### The Butterfly Fishes.

Body strongly compressed, elevated, suborbicular in outline. Mouth small, protractile, terminal. Eyes lateral, of moderate size. Maxillary very short, irregular in form, divided in two by a longitudinal suture. Upper part of skull solid, occipital crest strong. Post-temporal firmly joined to skull, its form really trifurcate, though appearing simple, and interspaces between forks filled by bone so that only a foramen is left. Last bone of suborbital ring firmly joined to preopercle. Teeth brush-like or setiform, often extremely long, in narrow bands in jaws. No teeth on vomer or palatines. No canines, molars or incisors. Gill-membranes more or less attached to isthmus. Gill-rakers very small. Pseudobranchiæ very large. Branchiostegals 6 or 7. Air-vessel present. Vertebrae  $10 + 14 = 24$ , anterior abbreviated. Insertion of ribs inferior. Post-temporal usually reduced and not bifurcate. Body covered with moderate-sized or small scales, finely ciliated or nearly smooth. Lateral line pres-

ent, concurrent with back and not extending on caudal fin. Dorsal fin single, continuous, its rays, sometimes filamentous, its soft part as well as soft part of anal densely covered with small scales. Anal similar to soft dorsal, with III or IV spines. Ventrals thoracic, I, 5. Caudal usually truncate.

Carnivorous fishes of the tropical seas, noted for their singular forms, brilliant colors and activity. The excessive quickness of sense and motion enable these fishes to maintain themselves in the struggle for existence in the close competition of the coral reefs, notwithstanding their bright colors. The young are very different from the adult, and pass through a stage termed *Tholichthys*, in which the membranes are greatly developed, forming collars and sheaths about the head and neck. Several species straying to our shores.

### *Key to the genera.*

- a. CHÆTODONTINÆ. Preopercle unarmed. CHÆTODON
- aa. POMACANTHINÆ. Preopercle armed at its angle with a very strong spine.
- b. Interopercle unarmed; vertical limb of preopercle above spine, entire or nearly so; D. VIII to XI, 23 to 32. POMACANTHUS
- bb. Interopercle short and broad, armed with 1 to 4 strong spines; preopercle serrate or spinous; vertical limb of preopercle with 3 to 9 conspicuous spines; D. about XIV, graduated, last spine longest; body ovate, much compressed. ANGELICHTHYS

### Genus CHÆTODON Linnæus.

#### The Butterfly Fishes.

#### *Key to the species.*

- a. Series of scales below axis of body running obliquely upward and backward, lowest becoming more or less horizontal; base of dorsal with a large black non-ocellated spot. OCELLATUS
- aa. Series of scales below axis of body running downward and backward, forming an angle with those above, and each series marked by a continuous black streak; body without ocelli. STRIATUS

#### *Chætodon ocellatus* Bloch.

PLATE 72.

Head  $2\frac{1}{2}$ ; depth  $2\frac{2}{5}$ ; D. XII, 18; A. III, 18; scales about 38 to base of caudal, several more on latter; 45 pores in lateral line; 9 scales between origin of spinous dorsal and lateral line; 22 scales between highest convexity of lateral line and origin of anal

in a vertical series; fourth dorsal spine  $1\frac{1}{3}$  in head, measured from tip of snout; ninth dorsal ray  $1\frac{5}{6}$ ; second anal spine 2; ninth anal ray  $2\frac{1}{10}$ ; pectoral  $1\frac{1}{3}$ ; ventral  $1\frac{1}{6}$ ; ventral spine  $1\frac{3}{5}$ ; least depth of caudal peduncle 3; caudal  $1\frac{3}{5}$ ; snout  $3\frac{1}{10}$ ; eye  $2\frac{3}{4}$ ; maxillary  $3\frac{1}{8}$ . Body ovate, deep. Head a little large, upper profile of snout concave above eye, convex, and then concave to dorsal. Eye large, circular and about median in length of head. Mouth small, mandible protruding. Maxillary not quite to orbit, reaching anterior nostril. Nostrils close together near eye above. Scales large on trunk, reduced, crowded and numerous on head and bases of spinous dorsal, rayed dorsal and anal. Anteriorly above lateral line rows of scales oblique and parallel with its course. Below lateral line they are similar entirely. Spinous dorsal inserted opposite origin of pectoral, graduated from third and fourth, which are longest, fin sloping down but little behind, and margin between first 6 deeply notched. Origin of rayed dorsal much nearer base of caudal than origin of spinous fin, broad, especially posteriorly. Anal spines well freed, second longest, and origin falling just behind last dorsal spine. Rayed anal rather broad anteriorly. Caudal broad, posterior margin convex. Pectoral falling a little short of anal. Ventral inserted a little behind origin of pectoral and reaching about to base of third anal spine. General color of sides yellow. A dark broad band from predorsal region slopes forward to eye, and passing through it, is continued down gradually narrower across side of cheek. Another dark band from lower anterior part of rayed dorsal is continued down across trunk just in front of caudal peduncle. Length  $1\frac{1}{4}$  inches. Beesley's Point.

(Bean.)

The occurrence of this fish is only known from our coast by Dr. Bean's figure and account, elaborated above. It is a Gulf Stream straggler.

*Chætodon maculocinctus* Bean, Bull. U. S. F. Com., VII, 1887, p. 138, Pl. 1, fig. 4.

*Chætodon striatus* Linnaeus.

Head 3; depth  $1\frac{2}{5}$ ; D. XII, 21; A. III, 17; scales in lateral line about 35, counting pores, to posterior base of rayed dorsal,

and about 37 in lateral series to base of caudal; 7 scales between origin of spinous dorsal and lateral line; 17 scales in a vertical series between lateral line and origin of spinous anal; snout 3 in head; eye  $2\frac{3}{4}$ ; maxillary 4; interorbital space  $3\frac{1}{3}$ ; fifth dorsal spine  $1\frac{2}{5}$ ; tenth dorsal ray  $1\frac{4}{7}$ ; third anal spine  $1\frac{2}{5}$ ; ninth anal ray about  $1\frac{4}{7}$ ; least depth of caudal peduncle  $2\frac{4}{7}$ ; length of caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{3}$ ; ventral  $1\frac{1}{10}$ ; ventral spine  $1\frac{3}{5}$ . Body ovate, strongly compressed, deep. Head small, compressed, and upper profile concave from snout to occiput. Eye large, circular, and about median in length of head. Mouth very small, terminal. Jaws even, with small slender flexible bristle-like teeth. Maxillary barely half way to orbit, not reaching anterior nostril. Preopercular margin with very slight obscure denticles. Interorbital space rather broad and a little convex. Nostrils close together in front of eye above. Gill-rakers 4 + 13 short rudiments, those on lower cerato-branchial longest. Body covered with ctenoid scales, large on trunk, and those on head and fins becoming very small, numerous and crowded distally. Anteriorly above lateral line rows of scales oblique and parallel with its course. Till about level with the eye same obtains below lateral line, though posteriorly as latter decurves along base of rayed dorsal rows persist in their former oblique courses. Below level of eye rows of scales oblique down and back so that if crossed by upper rows narrow triangles would form. Scale flap in axil of ventral about  $\frac{2}{5}$  length of spine. Spinous dorsal inserted just behind origin of pectoral, spines heteracanthous, graduated to fifth, which is longest, and margin of fin deeply notched. Rayed dorsal inserted posteriorly, much nearer base of caudal than origin of spinous fin, broad. Anal spines well freed, second longest, and origin about opposite base of ninth dorsal spine. Rayed anal broad, similar to rayed dorsal. Caudal broad and posterior margin a little convex. Pectoral reaching anal. Ventral longer than pectoral, inserted a little before origin of same and reaching a little beyond origin of spinous anal. Color in spirits yellowish, each row of scales on trunk with a narrow brown line. A dusky-brown band from nape obliquely down to and through eye, continued across cheek and interopercle. A second broader streak from first 3 dorsal spines down back of pectoral along side of ab-

domen and meeting its fellow below. A third band still broader above from tips of last dorsal rays sloping back below till across middle of base of anal. A dark streak obliquely back from tip of rayed dorsal across side of caudal peduncle and then continued down on anal basally. Margins of rayed dorsal and anal, and caudal, latter broadly, whitish. A broad submarginal band on each of these fins of brown, separated from whitish border by a darker shade of brown. Ventrals deep dusky-brown, spine pale. Fins otherwise pale. Length  $4\frac{7}{16}$  inches. Delaware Bay.

This species, evidently a straggler from tropical America, is only known to me from our shore by the above described example. It is in the collection of the Academy of Natural Sciences of Philadelphia, and was obtained many years ago from Dr. Harlan.

### Genus POMACANTHUS Lacépède.

#### The Black Angels.

*Pomacanthus arcuatus* (Linnæus).

PLATE 73.

#### Black Angel.

Head  $3\frac{1}{7}$ ; depth  $1\frac{1}{3}$ ; D. with 24 rays; A. III, 28; enlarged scales guessed at 44 in lateral line to base of caudal; about 8 enlarged scales between origin of rayed dorsal and lateral line; about 20 enlarged scales in a vertical series between origin of spinous anal and lateral line; second dorsal ray 2 in head and trunk; sixth anal ray  $1\frac{9}{10}$ ; first ventral ray  $2\frac{4}{5}$ ; pectoral 4; caudal  $4\frac{2}{5}$ ; snout 2 in head, measured from tip of upper jaw; eye  $3\frac{2}{3}$ ; maxillary 4; preopercular spine 4; least depth of caudal peduncle  $1\frac{3}{4}$ . Body deep, back elevated. Caudal peduncle short. Head short, its upper profile steep, at first concave with a little bulge just before eye, and then concave to dorsal. Snout long. Eye small, high, circular, and a little posterior in head. Jaws protruding, especially lower which projects beyond upper in front. Teeth fine, brush-like. Margin of preopercle oblique, entire, and base of its spine below front of orbit. Preopercular spine

long, directed posteriorly downwards. Branchiostegals well developed. Body covered with small scales, larger ones surrounded by many smaller ones, and without distinct series. Fins all more or less covered with very small scales, at least largely on their bases. Dorsal spines graduated to last, which are longest, and concealed by scales. Rayed dorsal apparently originating nearer beginning of caudal peduncle than origin of pectoral, and prolonged second ray pointed. Anals similar to dorsals, though origin of spinous portion much nearer origin of pectoral than beginning of caudal peduncle. Rayed anal with fifth ray longest, much longer than prolonged dorsal ray, and even extending beyond tip of caudal. Caudal cuneate, margin posteriorly convex. Pectoral broad, rounded, reaching beyond vent, but not to origin of spinous anal. Ventral inserted a trifle behind origin of pectoral, first ray prolonged till nearly twice length of spine and reaching a little beyond origin of anal. Color grayish, center of each scale on cheek blackish. Length about  $9\frac{1}{4}$  inches. Barnegat. (Jordan and Evermann.)

This is a most beautiful fish in life and is only known as a straggler to our shores from tropical America, perhaps more properly as a waif of the Gulf Stream. The above described example, figured by Drs. Jordan and Evermann is the only one I have yet noticed recorded from within our limits. The species varies greatly with age. It reaches a length of 2 feet and is not of value as a food-fish.

*Pomacanthus arcuatus* Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, II, 1898, p. 1679.—L. c., IV, 1900, Pl. 251, fig. 623.

### Genus ANGELICHTHYS Jordan and Evermann.

Isabelitas.

*Angelichthys ciliaris* (Linnæus).

Angel Fish.

Distinguished from the preceding by the interopercle having several strong spines, and also several conspicuous spines on vertical margin of preopercle.

Dr. Abbott records this fish from an example taken in Delaware Bay said to be in the collection of the Academy of Natural Sciences of Philadelphia. At present I am unable to locate it, and have no record of it on the Museum catalogues. Of course its place in our fauna is that of a tropical straggler. It is a large showy fish.

*Holacanthus ciliaris* Abbott, Geol. N. J., 1868, p. 811.

### Family HARPURIDÆ.

#### The Surgeon Fishes.

Body oblong, compressed and usually elevated. Eye lateral, high up. Preorbital very narrow and deep. Mouth small, low. Each jaw with a single series of narrow incisor-like teeth. Vomer and palatines toothless. Premaxillaries somewhat movable, but not protractile. Maxillary short, closely united with premaxillaries. Nostrils double. Gill-membranes attached to isthmus, openings thus restricted to sides. Gills 4, a slit behind fourth. Gill-rakers obsolete. Pseudobranchiæ large. Pelvic bones long, narrow, curved, closely connected, evident through skin as in *Balistidæ*. Pyloric cæca rather few. Air-vessel large. Intestinal canal long. Vertebrae  $9 + 13 = 22$ . Posterior sub-orbital bones in close contact with preopercle. Post-temporal immovably united with skull, apparently simple, but really trifurcate with interspaces filled in with bone, foramen not passing through it. Interneural bones with transversely expanded buckler-like subcutaneous plates which intervene between spaces and limit their motion forwards. Epipleurals developed from ribs. Body covered with very small scales. Lateral line continuous. Tail armed with 1 or more spines or bony plates. A single dorsal fin with strong spines, and spinous portion shorter than rayed portion. Anal. similar to rayed dorsal. Pectorals moderate. Ventrals present, thoracic, mostly 1, 5.

Herbivorous fishes of the tropical seas. They undergo changes with age as in the *Chatodontidæ*. One species straying to our shores.

Genus *HARPURUS* Forster.

The Doctor Fishes.

*Harpurus hepatus* (Linnæus).

Surgeon.

Distinguished from any of our other fishes by a very sharp knife-edged spine, erectile from a groove.

Known from our coast only by the record of Dr. Abbott. It is evidently a straggler in the Gulf Stream.

*Acanthurus phlobotomus* Abbott, Geol. N. J., 1868, p. 811.

Sub-Order **SCLERODERMI.**

The Hard Skinned Fishes.

Tropical fishes, mostly inactive, and depending on their tough skin or bony or spinous armature for their protection.

*Key to the families.*

- a. First dorsal of III, rarely II spines, first very large, and second locking it in erection; scales comparatively large, bony, rough, forming a coat of mail. BALISTIDÆ
- aa. First dorsal a single spine, with a rudiment at its base; scales minute, not bony, edges spinescent, so that surface of body is rough-velvety. MONACANTHIDÆ

Family **BALISTIDÆ.**

The Trigger Fishes.

Body oblong or ovate, moderately compressed. Eye near occiput. Mouth small, terminal, low. Jaws short, each with about 1 series of separate incisor-like teeth. Preorbital very deep. Chin without barbel. Gill-openings small, slit-like, above or in front of pectoral fins and not before eyes. Body covered with rather large rough scales, or scutes of varying form, scutes not forming an immovable carapace. Lateral line obscure or wanting. Post-



temporal short, simple, forks obliterated, bone grown solidly to skull and with no foramen. Vertebrae reduced, 17. Dorsal fins 2, anterior of II or III spines, first highest, very strong, second locking it in erection. Second dorsal remote from first, of many soft rays. Caudal rounded or forked. Ventrals wanting, their place occupied by a single stout thick spine at end of very long usually movable pubic bone.

Shore-fishes of the tropical seas of rather large size, carnivorous or partly herbivorous, and very rarely used as food for many are reputed poisonous. One species on our shores.

### Genus BALISTES Linnæus.

#### The Trigger Fishes.

**Balistes carolinensis** Gmelin.

PLATE 74.

#### Trigger Fish. File Fish.

Gill-opening with a number of enlarged bony plates or scutes posteriorly, teeth unequal, oblique and each one deeply notched. Dorsal and anal falcate in adult. Caudal peduncle unarmed.

A tropical species occasionally on our coast.

*Balistes carolinensis* Moore, Bull. U. S. F. Com., XII, 1892, p. 363.

*Capriscus fuliginosus* Abbott, Geol. N. J., 1868, p. 826.

### Family MONACANTHIDÆ.

#### The File Fishes.

Body much compressed. Upper jaw with a double series of incisor-like teeth, 6 in outer and 4 in inner series. Lower jaw with 6 similar teeth in a single series. No barbel. Vertebrae  $7 + 11$  to  $14 = 18$  to  $21$ . Body covered with very small rough scales forming a velvety covering. Males sometimes with spines on caudal peduncle. First dorsal with a single strong spine and generally a rudimentary one behind it. Second dorsal long,

similar to anal. Ventrals reduced to a simple small osseous appendage at end of long pelvic bone, fixed, movable, often rudimentary or entirely absent.

Herbivorous fishes of the shores in warm seas closely related to the *Balistida*, differing chiefly in having the first dorsal as a single spine, with a posterior rudiment sometimes, and a rough-velvety skin. Species mostly of small size with little flesh of bitter taste, and therefore not used as food. Two occur on our coast.

### *Key to the genera.*

- a. Pubic bone with small terminal spine; gill-opening short, nearly vertical; D. and A. less than 40; pelvic spine movable; usually 2 series of strong retrorse barbs on dorsal spine. STEPHANOLEPIS
- aa. Pubic bone without spine at end; gill-opening long, oblique; D. and A. 40 or more; dorsal spine without barbs, inserted above orbit. ALUTERA

### Genus *STEPHANOLEPIS* Gill.

#### The Leather Fishes.

#### *Stephanolepis hispidus* (Linnæus).

PLATE 75.

File Fish. Thread File Fish. Fool Fish.

Distinguished from the next chiefly by its generic characters, such as the small spine at end of pubic bone, etc.

I have no New Jersey examples. It reaches a length of 10 inches.

*Monacanthus hispidus* Bean, Bull. U. S. F. Com., VII, 1887, p. 133.

*Canthorinus broccus* Abbott, Geol. N. J., 1868, p. 826.

*Canthorinus massachusettsensis* Abbott, l. c.

*Canthorinus scgnaifer* Abbott, l. c.

Genus *ALUTERA* Cuvier.

## The File Fishes.

*Alutera schœpfii* (Walbaum).

## PLATE 76.

## Orange File Fish. Sun Fish. Unicorn Fish.

Head  $3\frac{2}{5}$ ; depth  $2\frac{2}{5}$ ; D. 37; A. 42; snout  $1\frac{1}{10}$  in head measured from tip of mandible; eye  $5\frac{2}{3}$ ; interorbital space  $4\frac{7}{8}$ ; height of interorbital space  $3\frac{1}{3}$ ; twelfth dorsal ray  $3\frac{4}{7}$ ; twenty-first anal ray  $3\frac{2}{3}$ ; least depth of caudal peduncle  $3\frac{2}{5}$ ; pectoral  $3\frac{1}{3}$ ; caudal  $2\frac{7}{8}$  in head and trunk. Body oblong or rather elongate, strongly compressed, edges trenchant. Head large, lower profile evenly convex. Snout long, with concave profile. Eye circular, high, small, and its posterior margin about midway between tip of snout and origin of dorsal. Mouth small. Upper jaw with a double series of incisor-like teeth. Lower jaw with uniserial incisors directed obliquely upward and backward as mandible protrudes. Teeth unequal and connivent. A slight depression at base of upper jaw. Interorbital space high. Gill-opening an oblique slit equal to twice eye-diameter, placed below and in advance of same, and its posterior end behind base of pectoral. Body covered with minute rough scales, shagreen-like and uniform. Dorsal spine small, inserted above anterior margin of eye, rough, without barbs. Rayed dorsal at highest obtuse angle of upper profile, or midway between origin of dorsal spine and base of its last ray. Anal similar and inserted about opposite. Caudal long, convex. Pectoral small, inserted opposite anterior margin of pupil. Pelvic bone long, falcate, movable under skin, and without terminal spine. Color dirty-gray. Length  $10\frac{1}{4}$  inches. Beesley's Point.

Reaches a length of 2 feet and useless as food. I also have examples from Squan River.

*Alutera schœpfii* Bean, Bull. U. S. F. Com., V, 1887, p. 134.—Moore, Bull. U. S. F. Com., XII, 1892, p. 363.

*Ceratacanthus aurantiacus* Abbott, Geol. N. J., 1868, p. 827.

*Alutera cuspidata* Abbott, l. c.

**Sub-Order OSTRACODERMI.****The Trunk Fishes.**

Represented by a singular family, the only one in this group.

**Family OSTRACIIDÆ.****The Trunk Fishes.**

Body short, cuboid, triquetrous or pentagonal, covered by a carapace formed of firmly united polygonal bony patches. Jaws, bases of fins and caudal peduncle covered by smooth skin and free. Maxillaries and premaxillaries firmly united. Gill-opening a nearly vertical slit, below and behind the eye. Vertebrae 14, anterior 9 elongate, last 5 extremely short. No ribs. Dorsal single, short, without spine. Anal short, similar to dorsal. Caudal rounded. No ventrals.

Fishes of the tropical seas living near the bottom in shallow waters. They are so singular in appearance and so easily preserved that they have been common in collections ever since collecting tropical curiosities began. One species straying to our shores.

**Genus LACTOPHRYS Swainson.****The Trunk Fishes.****Lactophrys trigonus (Linnaeus).****Trunk Fish.**

Known from all of our other fishes by the bony carapace, which is without spines and closed behind dorsal fin.

I have never seen any examples, though a trunk fish, most likely this species, has been reported to me from Cape May. Most likely Dr. Abbott's reference is to this species. It reaches about a foot in length.

?*Tetrasomus camelinus* Abbott, Geol. N. J., 1868, p. 827.

**Sub-Order GYMNODONTES.****The Puffers.**

These are degraded plectognaths without spinous dorsal, distinct teeth, or scales.

*Key to the families.*

- a.* Caudal region normal, caudal peduncle developed
  - b.* Jaws divided by median suture, maxillaries and dentaries each curved outward behind premaxillaries. TETRODONTIDÆ
  - bb.* Jaws undivided, premaxillaries and dentaries co-ossified into sutureless arches. DIODONTIDÆ
- aa.* Caudal region aborted, body truncated behind dorsal and anal; jaws without median suture. MOLIDÆ

**Family TETRODONTIDÆ.****The Puffers.**

Body oblong or elongate, usually little compressed, sometimes very broad. Head and snout broad. Each jaw confluent, forming a sort of beak, which in each jaw is divided by a median suture. Maxillaries curved outward behind premaxillaries. Lips full. Nostrils various. Gill-openings small, placed close in front of pectorals. Medifrontals articulated with supraoccipital, postfrontals confined to sides, ethmoid more or less projecting in front of frontals. Postfrontals extending outward as far as frontals. Prosethmoid short and narrow, little prominent to view above. No ribs. Vertebræ few, 7 or 8 + 9 to 13. Caudal vertebræ normally developed. Air-vessel present. Belly capable of great inflation. Skin scaleless, usually more or less prickly, spines or prickles usually weak and movable, not rooted. Skin armed with bony scutes forming a sort of carapace sometimes. Spinous dorsal and ventral wanting, fins composed of soft rays only. Dorsal posterior, opposite and similar to anal. Caudal distinct. Pectorals short, broad, upper rays longest. Ventrals none, pelvic bone undeveloped.

Fishes of sluggish habit in warm seas. Noted for their habit of filling the stomach with air when distrubed, and then floating on the surface of the water belly upward. They are not used as food, the flesh ill-flavored and reputed poisonous. Two species on our coast.

*Key to the genera.*

- a. D. and A. comparatively long, falcate, 12 to 15.  
aa. D. and A. comparatively short, rounded, 6 to 8.

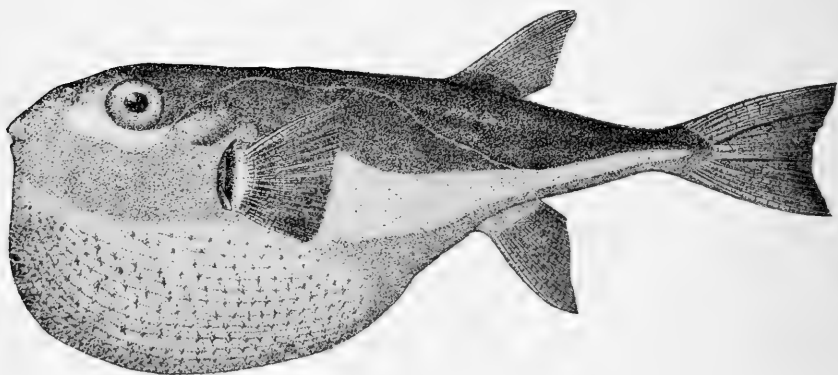
LAGOCEPHALUS  
SPHEROIDES

Genus LAGOCEPHALUS Swainson.

The Rabbit Fishes.

**Lagocephalus lævigatus** (Linnæus).

Puffer. Rabbit Fish.



Rabbit Fish. *Lagocephalus lævigatus* (Linnæus).

Head  $3\frac{1}{2}$ ; depth  $3\frac{2}{3}$ ; A. I, 12; A. I, 11; width of head  $1\frac{2}{3}$  in its length; snout 2; eye  $4\frac{3}{5}$ ; mouth  $5\frac{3}{4}$ ; interorbital space  $2\frac{1}{5}$ ; dorsal along anterior margin  $1\frac{7}{8}$ ; anal 2; upper caudal lobe  $1\frac{2}{5}$ ; least depth of caudal peduncle  $5\frac{1}{3}$ ; pectoral 2. Body elongate. Caudal peduncle long, tapering till rather slender, depressed somewhat, and each side below with a fold. Head large, robust. Snout long, convex. Eye large, elongate, high and near last  $\frac{2}{5}$  in length of head. Teeth large. Lips very thick, fleshy and papillose. Interorbital space broad and flattened. Nostril

without distinct openings. Gill-opening nearer snout than dorsal, its length  $3\frac{1}{2}$  in head. Body mostly smooth, but belly covered with large subequal 3-rooted spines, no smaller ones intermixed, and well separated. Dorsal falcate, inserted nearly midway between origin of pectoral and base of caudal. Anal opposite. Caudal lunate, upper lobe a little longer. Pectoral broad, a little less than half way to dorsal. Olive-greenish above, below white. Length 20 inches. Atlantic City.

Color when freshly caught beautiful olive-brown above, becoming more or less dusky on upper surface of caudal peduncle. Lines of demarcation of darker color on head and back distinct, and color just below this more or less silvered. Side of body on same region, and also extending well below, beautiful citron-yellow or green. This latter bounded below by lateral keel, and above color between is seen to have a beautiful pale plumbeous shade in some lights. Lips pale brownish-yellow, and upper much paler than rest of upper surface of head. Lower surface of body chalky-white, and on posterior portion or on lower surface of caudal peduncle, chalky-white with an ochraceous-yellow tinge. Anal chalky-white. Inside of gill-opening black. Beak pale horn-color. Eye slaty, and marginally iris with a narrow greenish-yellow ring. Dorsal and caudal olive-brown, upper margin of latter dark and lower lobe a little pale. Pectoral dilute olive-gray. One taken August 13th, 1904, in Delaware Bay. A letter states that it grunted like a pig and fought hard for its life when hauled on board. It also inflated its body and was more or less transparent, similar in shape to a large basket. Length about 2 feet. Another example showed the following when fresh. Slaty-brown on back, side becoming paler, and median line of back more or less nebulous with dusky-slate. Side of body to lower lateral fold gilded or washed with metallic silvery and grayish reflections, below opaque chalky or milky-white. Dorsal dusky-brown, anterior edge dark and posterior or upper edge paler. A tinge of dusky dots submarginally on dorsal. Caudal more or less slaty, tip of each lobe milky-white. Anal pale brownish. Pectoral pale brownish, darker basally. Inside of gill-opening slaty. Iris pale or citron-white. Length  $1\frac{1}{2}$  inches. Sea Isle City. Wm. J. Fox.

I also have others from Cape May and Beesley's Point. It does not, however, appear to be especially abundant, most of the examples having fallen under my notice at odd times.

*Lagocephalus lævigatus* Abbott, Geol. N. J., 1868, p. 827.—  
Bean, Bull. U. S. F. Com., VII, 1887, p. 133.

### Genus SPHEROIDES Lacépède.

#### The Swell Fishes.

#### *Spheroides maculatus* (Schneider).

PLATE 77.

Toad Fish. Common Puffer. Swell Fish. Puffer.

Head  $2\frac{4}{5}$ ; depth 3; A. 1, 6; A. 1, 6; snout 2 in head; eye  $5\frac{3}{5}$ ; interorbital space  $3\frac{2}{5}$ ; first dorsal ray  $2\frac{3}{4}$ ; first anal ray  $3\frac{1}{5}$ ; least depth of caudal peduncle  $5\frac{1}{5}$ ; caudal  $2\frac{1}{10}$ ; pectoral  $2\frac{1}{3}$ . Body about as wide as deep when not inflated. Head large, upper profile more convex than lower. Snout long, convex, profile straight. Eye elongate, high, a little posterior. Teeth large. Lips broad and fleshy. A single short simple nasal tube, with 2 rather large openings near its tip, and placed about last third in snout. Interorbital space a trifle concave. Gill-opening obliquely back, reaching below till opposite middle of base of pectoral. Sides of head and body prickly, also back from upper lip to base of dorsal. Belly prickly from lower lip to vent. Prickles all similar, 3-rooted, stiff, small, close-set, largest rather posteriorly on back and belly. Dorsal inserted about last fourth in length of head and trunk. Anal similar, inserted just before base of last dorsal ray. Caudal with convex margin. Pectoral broadly convex, reaching one-third of space to anal. Color dark olivaceous above, somewhat marbled and dotted with black. Length 10 inches. Beesley's Point.

Common along the coast, reaching a length of 10 inches. My examples from Cape May, Anglesea, Stone Harbor, Sea Isle City and Atlantic City. At Stone Harbor they have been found exceedingly abundant in the fall by Mr. David McCadden.



*Orbidus maculatus* Moore, Bull. U. S. F. Com., XII, 1892, p. 363.

*Tetraodon turgidus* Baird, 9th An. Rep. Smiths Inst., 1854, p. 352.

*Gastrophysus turgidus* Abbott, Geol. N. J., 1868 p. 827.

*Tetrodon turgidus* Bean, Bull. U. S. F. Com., VII, 1887, p. 133.

### Family DIODONTIDÆ.

#### The Porcupine Fishes.

Body short, broad, depressed above. Caudal peduncle short and slender. Eye rather large. Mouth moderate, terminal, each jaw covered with a bony plate like beak of bird, these not divided by median suture. Nostrils on each side forming a small tentacle, usually with 2 openings. Gill-openings moderate, immediately in front of pectorals. Belly moderately inflatable, covered everywhere except on lips and caudal peduncle with spines, which are usually 2-rooted or 3-rooted at their bony base. Dorsal and anal short, similar to each other, rounded in form and placed posteriorly.

Sluggish fishes living on the bottom among weeds and corals in tropical seas. When disturbed they swallow air and float belly upward on the water. Their capacity of inflation is very much less than that of the *Tetrodontida*, from which they differ chiefly in the stronger armature and in having no division in the bony plate of either jaw. They are rarely used as food, being generally regarded as poisonous. The species are well known in collections, having attracted the attention of travellers in the earliest times. Two species have been recorded from our shores.

#### Key to the genera.

- |  |               |
|--|---------------|
| a. Each dermal ossification as a 2-rooted fine flexible spine, or hair-like bristle. | TRICHODIODON  |
| aa. Each dermal ossification as usually a 3-rooted short stiff immovable spine.      | CHILOMYCTERUS |

## Genus TRICHODIODON Bleeker.

## The Hairy Fishes.

*Trichodiodon pilosus* (Mitchill).

## Balloon Fish.

This differs from the other members of the family in the very small dermal ossifications, each of which is 2-rooted with a fine flexible spine or hair-like bristle.

This species, very imperfectly understood, has been recorded by Dr. Abbott, who states that it is occasionally met with, a statement, however, which needs verification. Its capture within our limits is certainly to be questioned as yet.

*Diodon pilosus* Abbott, Geol. N. J., 1868, p. 827.

## Genus CHILOMYCTERUS Bibron.

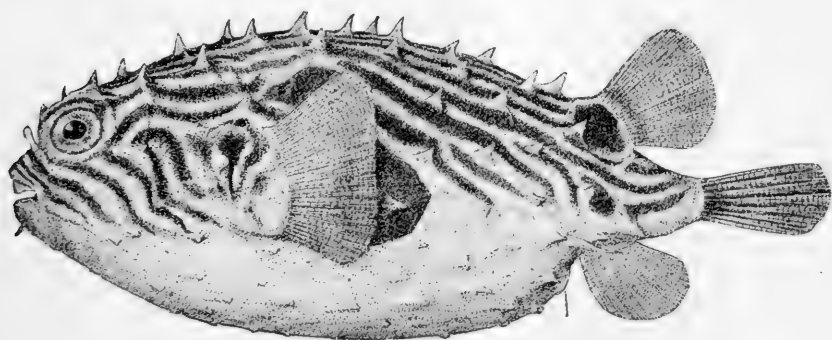
## The Burr Fishes.

*Chilomycterus schoepfi* (Walbaum).

Burr Fish. Cucumber Fish. Spotted Balloon Fish. Balloon Fish.

Head  $2\frac{3}{4}$ ; depth 3; D. 1, 9; A. 1, 9; snout  $2\frac{1}{3}$  in head; eye  $4\frac{1}{3}$ ; width of mouth  $2\frac{1}{2}$ ; interorbital  $1\frac{1}{3}$ ; fourth dorsal ray  $2\frac{1}{2}$ ; fourth anal ray  $2\frac{3}{4}$ ; caudal  $1\frac{2}{3}$ ; pectoral  $1\frac{2}{3}$ . Body depressed, convex above, flattened below, or rather inflatable. Head broad, depressed above, and flattened below. Snout broad, obtusely convex. Eye circular, anterior. Mouth a little broad, with thick fleshy wrinkled lips. Interorbital space broadly concave. Gill-opening before upper part of base of pectoral. About 9 spines between eye and dorsal, their height about equal to diameter of pupil. Spines on belly much smaller, partly imbedded in skin. No spines on caudal peduncle. Anterior root of each spine little larger than others. Dorsal inserted far back, reaching base of caudal when depressed. Anal nearly opposite dorsal, but a trifle posterior. Pectoral broad, reaching  $\frac{3}{5}$  of space to origin of dorsal.

Color when fresh a beautiful pale or translucent brownish generally, above with broad vermiculating lines of much deeper brownish. At base of dorsal blotch enclosed is jet-black, another just above pectoral basally and another about opposite middle of base of pectoral, also a fourth about size of pupil below base of dorsal opposite vent laterally. Lower surface of body bright orange or cadmium-yellow, dusted on lower surface of head and caudal peduncle with pale brownish, and at articulation of each ramus of mandible with same. Dorsal and caudal dilute translucent brownish, ventral slightly tinted with orange. Pectoral dilute brownish becoming tinted with pale golden below. Spines on back pale horn-color or brownish, those on lower surface pale, enveloped more or less with orange pigment of that region. Lips



Burr Fish. *Chilomycterus schæpfi* (Walbaum).

pale translucent yellowish or orange-brown. Nasal tenticle orange, and orange tint of lower surface also somewhat reflected on lateral spines. Iris with metallic pale brassy or brownish shell-like effects. Pupil slaty. Length  $8\frac{1}{2}$  inches. Sea Isle City, Sept. 10th, 1905. Wm. J. Fox.

Apparently abundant at times. My examples from Cape May, Atlantic City and Beesley's Point. It reaches a length of 10 inches and has less power of inflating than our puffers. It prefers shallow water.

*Chilomycterus schæpfi* Moore, Bull. U. S. F. Com., XII, 1892, p. 364.

*Diodon maculo-striatus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 351.

*Diodon fuliginosus* Baird, l. c.

*Chilomycterus fuliginosus* Bean, Bull. U. S. F. Com., VII, 1887, p. 133, from Baird.

*Chilomycterus gometricus* Abbott, Geol. N. J., 1868, p. 827.—Bean, l. c.

### Family MOLIDÆ.

#### The Head Fishes.

Body oblong or more or less short and deep, compressed, truncate behind so that there is no caudal peduncle. Mouth very small, terminal. Teeth completely united in each jaw, forming a bony beak without median suture, as in the *Diodontidæ*. Gill-openings small, in front of pectorals. An accessory opercular gill. Belly not inflatable. No air-vessel. Skin rough, naked, spinous or tessellated. Dorsal and anal similar, falcate in front, and posterior parts more or less perfectly confluent with caudal around tail. No spinous dorsal or ventrals. Pectorals present. Pelvic bone undeveloped.

Pelagic fishes reaching a very large size in most warm seas, apparently composed of a huge head to which small fins are attached. The young are variously shortened in form and armed with spines. The flesh is not used as food as it is coarse and tough. A single species frequently on our coast.

#### Genus MOLA Cuvier.

#### The Ocean Sun Fishes.

#### *Mola mola* (Linnæus).

PLATE 78.

Ocean Sun Fish. Sun Fish. Globe Fish. Head Fish.

Head 3; depth  $1\frac{2}{3}$ ; D. 16; A. 16; snout  $2\frac{1}{10}$  in head; eye 7; pectoral 5; interorbital space  $2\frac{1}{6}$ ; height of dorsal 3; height of anal  $2\frac{4}{7}$ . Body ovate, strongly compressed, short, deep and lower profile more convex. Snout long, with a projecting fleshy

nose. Eye small, circular, and little anterior in head. Mouth small, upper jaw even. Interorbital space high and convex. Gill-opening just below eye, oblique, and about equal to eye-diameter. Body covered with thick rough elastic skin. Dorsal inserted about midway between gill-opening and tip of caudal. Anal a little anterior and confluent with dorsal around tail by means of caudal which is low and wavy. Color grayish. Length 44 inches. Anglesea.

A large clumsy pelagic fish reaching a length of over 8 feet and a weight of 1800 pounds. They are usually seen swimming slowly with the elevated dorsal above the water, sometimes turning over on its side. An example 4 feet 8 inches long, weighed about 200 pounds. It was taken in the surf off Cape May, Nov. 1st, 1903. Another taken at Sea Isle City on July 20th, 1905, was reported by Mr. Wm. J. Fox. In fact most every summer several occur. I also have other records for Cape May. The young are very different in appearance, with a much compressed deep body and with caudal replaced by a series of marginal spines.

*Orthogoriscus mola* Abbott, Geol. N. J., 1867, p. 827.

*Molacanthus carinatus* Abbott, l. c.

### Sub-Order PAREIOPLITÆ.

#### The Mailed Cheek Fishes.

A large group distinguished chiefly by the presence of the bony stay or backwardly directed process from the third suborbital extending across cheek toward preopercle.

#### *Key to the families.*

- a. Ventrals not united or forming a round sucking-disk; a well-developed spinous dorsal usually.
- b. Body covered with scales mostly, never with plates.
- c. Anal spines III. SCORPÆNIDÆ
- cc. No anal spines. COTTIDÆ
- bb. Body covered with plates arranged in about 8 longitudinal rows; spinous dorsal short or wanting. AGONIDÆ
- aa. Ventrals completely united to form a round sucking-disk, rarely obsolete; spinous dorsal little developed. CYCLOPTERIDÆ

**Family SCORPÆNIDÆ.**

## The Rock Fishes.

Body oblong, more or less compressed. Head large, with 1 or more pairs of ridges above which usually terminate in spines. Mouth terminal, usually large, with villiform teeth on vomer and in jaws, also usually on palatines. Premaxillaries protractile. Maxillary broad, without supplemental bone, not slipping under preorbital. Opercle usually with 2 spinous processes, preopercle with 4 or 5. Gill-openings wide, extending forward below. Gill-membranes separate and free from isthmus. Usually no slit behind fourth gill. Pseudobranchiæ large. Air-vessel usually present. Pyloric cœca in small or moderate number, less than 12. A narrow bony stay extending backward from suborbital toward preopercle. Actinosts moderate, inserted on posterior edges of hypercoracoid and hypocoracoid. Ribs borne on enlarged pleurapophyses. Post-temporal bifurcate, normally connected. Myodome more or less developed. Scales ctenoid, sometimes nearly obsolete. Lateral line single, continuous, concurrent with back. Dorsal continuous, sometimes so deeply notched as to divide it into 2 parts with VIII to XVI rather strong spines and about as many soft rays. Anal rather short, with III spines and 5 to 10 soft rays. Soft rays of all fins branched, except some or all pectoral rays. Ventrals thoracic, of normal Percoid form, I, 5, rays branched.

Fishes living about rocks, non-migratory, mostly of large size, and all used as food. Many are viviparous, producing young in great numbers when about  $\frac{1}{4}$  of an inch in length. They are especially abundant in the temperate parts of the Pacific Ocean. One species recorded from our shores.

## Genus SEBASTES Cuvier.

## The Rose Fishes.

**Sebastes marinus** (Linnæus).

## PLATE 79.

## Red Sea Perch.

Dorsal usually with XV spines, and anal with 7 or 8 soft rays, also pectoral long and narrow.

A bright red fish of the northern seas which is occasionally taken off our north shore in deep water. It reaches a length of 18 inches, and is a valuable food-fish. I have no examples.

*Sebastes norvegicus* Abbott, Geol. N. J., 1868, p. 816.

### Family COTTIDÆ.

#### The Sculpins.

Body moderately elongate, fusiform or compressed, tapering backward from head. Head usually broad and depressed. Eyes placed high. Teeth equal, in villiform or cardiform bands in jaws and often on vomer and palatines. Premaxillaries protractile. Maxillary without supplemental bone. Interorbital space usually narrow. A bony stay connecting suborbital with preopercle, usually covered by skin. Upper angle of preopercle usually with 1 or more spinous processes, head again sometimes wholly unarmed. Gill-membranes broadly connected, often joined to isthmus. Gills  $3\frac{1}{2}$  to 4, slit behind last small, often obsolete. Gill-rakers short, tubercle-like or obsolete. Pseudobranchiæ present. Vertebrae numerous, 30 to 50. Scapular arch normal. Myodome developed. Actinosts large, partly intervening between hypercoracoid. Ribs sessile on vertebrae. Pyloric cæca usually in small number, 4 to 8. Air-vessel commonly wanting. Body naked or variously armed with scales, prickles or bony plates, but never uniformly scaled. Lateral line present, simple, sometimes chain-like. Dorsal fins separate, or somewhat connected, spines VI to XVIII, usually slender, sometimes concealed in skin, and soft part elongate. Anal similar to soft dorsal, without spines. Caudal separate, rounded. Pectorals large, with broad procurrent bases, rays mostly simple, and upper sometimes branched. Ventrals thoracic, rarely entirely wanting, insertion well forward, and usually I, 3, to I, 5.

A large family of rock-pool and shore-fishes of northern regions, many also in fresh water, and others found at great depths in the sea. They are mostly of small size and singular aspect, and none are valued as food.

*Key to the genera.*

- a. COTTINÆ. Spinous dorsal shorter than soft part, less than XIII spines.  
 b. Gill-membranes broadly united to isthmus, not forming a fold across it; fresh-water forms with feebly armed head. URANIDEA  
 bb. Gill-membranes free from isthmus or else forming a broad fold across it. MYOXOCEPHALUS  
 ac. HEMITRIPTERINÆ. Spinous dorsal longer than soft part, of XIV to XVIII spines. HEMITRIPTERUS

## Genus URANIDEA DeKay.

## The Blobs.

*Uranidea gracilis viscosa* (Haldeman).

## Blob. Star Gazer.

Head 3; depth  $4\frac{1}{2}$ ; D. IX, 18; A. 12; width of head  $1\frac{2}{3}$  in its length; snout  $3\frac{2}{3}$ ; eye 4; maxillary  $2\frac{1}{4}$ ; interorbital space 7; least depth of caudal peduncle  $4\frac{1}{3}$ ; pectoral  $1\frac{1}{6}$ ; ventral  $1\frac{7}{8}$ . Body rather slender, fusiform, compressed. Head moderately broad, convex above, and flattened below. Snout convex, rounded. Eye ellipsoid, well anterior and superior. Mouth moderately large, and jaws about even. Maxillary reaching middle of orbit. Teeth in jaws in broad bands, villiform. Vomerine teeth villiform. Interorbital space level, a little depressed anteriorly. Preopercle spine broad. Opercle ending in concealed spine. Gill-rakers a few short stumpy tubercles. Skin smooth. Origin of spinous dorsal opposite that of pectoral. Origin of rayed dorsal a little nearer base of caudal than tip of snout, and its base twice that of spinous dorsal. Anal inserted a little posterior and tips of radii free or edge of fin notched. Caudal rounded. Pectoral large, reaching a little beyond anal, and radii of lower half of fin graduated down forwards with their tips free. Ventral inserted a trifle behind lowest pectoral ray,  $\frac{2}{3}$  of space to anal. Color olivaceous, mottled, upper edge of spinous dorsal pale. Length  $3\frac{1}{2}$  inches. "Beesley's Point."

The above-described example is the only New Jersey one I have. The occurrence of the species near Beesley's Point is per-



haps doubtful, though I include it as the original label is tied to the fish, and states that it is from the old Ashmead collection. Mr. Eugene Smith records it from the Saddle River and the Hackensack.

*Cottus gracilis* E. Smith, Proc. Linn. Soc. N. Y., IX, 1896, p. 48.

### Genus MYOXOCEPHALUS Tilesius.

#### The Great Sculpins.

#### *Key to the species.*

- a.* Upper preopercular spine shorter than eye; anal 10. ÆNEUS
- aa.* Upper preopercular spine very long, longer than eye, reaching beyond tip of opercular spine, and its length more than 4 times that of spine below it; anal 14. OCTODECIMSPINOSUS

#### **Myoxocephalus æneus** (Mitchill).

#### Sculpin.

Distinguished from the next chiefly by the fewer anal rays and short preopercular spine.

This is a small species reaching about 8 inches and occurs in seaweed near shore. I have no New Jersey examples.

*Acanthocottus æneus* Abbott, Geol. N. J., 1868, p. 817.

*Acanthocottus mitchilli* Abbott, l. c.

#### **Myoxocephalus octodecimspinosus** (Mitchill).

#### PLATE 80.

#### Common Sculpin. Bull Head.

Head  $2\frac{3}{5}$ ; depth 5; D. IX-17; A. 14; snout  $3\frac{2}{3}$  in head, measured from tip of upper jaw; eye  $4\frac{3}{4}$ ; maxillary  $2\frac{2}{5}$ ; inter-orbital space 7; third dorsal spine  $2\frac{2}{5}$ ; fourth dorsal ray  $2\frac{2}{5}$ ; fifth anal ray  $3\frac{1}{2}$ ; least depth of caudal peduncle 7; caudal  $1\frac{5}{6}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $2\frac{1}{6}$ . Body very slender, tapering to long slender caudal peduncle. Head long, depressed, comparatively

narrow. Snout convexly elevated. Eye elongate, large, elevated and well anterior. Pupil elongate. Upper jaw projecting a little. Maxillary a little past middle of eye, and its distal expansion equals about  $\frac{3}{7}$  of horizontal orbital diameter. Bands of fine teeth in jaws and on vomer. Interorbital space concave, flattened medianly, and vertex also flat, bounded by low ridges. Upper preopercular spine extremely long, a trifle more than horizontal orbital diameter, extending almost to tip of opercular spine, and its length more than 4 times that of small spine below. A lower preopercle spine turned forward. Nasal spines strong. A strong spine at upper posterior margin of orbit directed upward and backward. Occipital ridges low, long, converging behind, each ending in a similar spine, sharp, and directed backward. A single sharp suprascapular spine. A sharp spine on shoulder-girdle at tip of sharp opercular spine. Usual downward-directed spines on preopercle and subopercle. Gill-rakers  $1 + 9$  broad asperous tubercles. No cirri on head, and skin smooth. No rough tubercles. Lateral line with a series of partly concealed cartilaginous plates. Spinous dorsal inserted midway between front rim of pupil and origin of rayed dorsal, margin of fin with slight notches. Rayed dorsal entire, inserted midway between middle of orbit and base of caudal. Anal a little posterior, tips of radii free and insertion of fin about midway between posterior margin of orbit and base of caudal. Caudal truncate, edges rounded. Pectoral long, nearly to origin of anal. Ventral inserted a little nearer origin of anal than tip of mandible, and reaching  $\frac{5}{8}$  of space to anal. Color brown with 4 obscure dark cross-bars. Fins barred and mottled. Head below and belly white. Length  $12\frac{1}{2}$  inches. Absecom.

My examples from the above and Beesley's Point. It is a coarse fish and said to be of little value as food. It may easily be identified by the long strong preopercular spine.

*Acanthocottus octodecim-spinosus* Abbott, Geol. N. J., 1868, p. 816.

*Cottus octodecimspinosus* Bean, Bull. U. S. F. Com., VII, 1887, p. 137.

*Acanthocottus virginianus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 328.

## Genus HEMITRIPTERUS Cuvier.

## The Sea Ravens.

*Hemitripterus americanus* (Gmelin).

## PLATE 81.

## Sea Raven.

Head  $2\frac{1}{2}$ ; depth 4; A. IV, XII-I, 12; A. 13; tubercles in lateral line about 45 to base of caudal; snout  $3\frac{3}{4}$  in head, measured from tip of upper jaw; eye  $6\frac{2}{3}$ ; maxillary  $1\frac{15}{16}$ ; inter-orbital space  $3\frac{3}{5}$ ; width of mouth  $1\frac{4}{5}$ ; second dorsal spine 2; sixth dorsal ray  $2\frac{1}{10}$ ; ninth anal ray  $2\frac{1}{10}$ ; least depth of caudal peduncle  $5\frac{1}{2}$ ; caudal  $1\frac{3}{5}$ ; pectoral  $1\frac{1}{6}$ ; ventral  $2\frac{1}{4}$ . Body moderately elongate. Head large, broad, well convex above, flattened below. Snout broad, convexly elevated. Eye elongate or ellipsoid, in first third of head and high. Mouth very wide, nearly horizontal. Mandible protruding. Maxillary reaching a little beyond eye. Teeth slender, sharp, conic, numerous and in rather broad bands in jaws, on vomer and palatines. Inter-orbital space and top of head medianly concave, former with a large depression in shape of plumb-bob. Nasal spines strong. Supraocular ridge much elevated, with 2 blunt osseous tubercles. On each side of occiput 2 blunt osseous tubercles, outside of which and a little anterior 3 others. Opercle small, with bony ridge. Posterior margin of preopercle with 2 strong blunt spines, lower longer and horizontal. Suborbital stay very strong, forming a sharp ridge. Gill-rakers as several broad finely asperous tubercles. Body villous, prickles enlarged and tubercle-like along back and lateral line. Supraocular ridge with 2 dermal flaps, and 3 pairs of fleshy flaps on nasal bones. Smaller ones on maxillary and preorbital, several on lower jaw. Spinous dorsal much longer than soft part, first 2 spines highest, and origin of fin about midway between tip of snout and base of tenth spine. Fourth and fifth shorter than those succeeding and fin deeply notched. Rayed dorsal inserted about midway between origin of pectoral and base of caudal, margin entire and a little higher

in front. Anal inserted a trifle before origin of rayed dorsal, higher posteriorly, and margin deeply notched. Caudal rounded, median rays longest. Pectoral long, reaching base of second anal ray. Ventral inserted midway between tip of mandible and origin of anal, reaching  $\frac{4}{7}$  to anal. Color brownish, variegated and marbled darker. Length 14 inches. Beesley's Point.

A large fish of singular appearance, known from our coast only at the above locality from 2 examples taken many years ago by Samuel Ashmead.

*Hemitripteris americanus* Abbott, Geol. N. J., 1868, p. 816.

### Family AGONIDÆ.

#### The Alligator Fishes.

Body angular, commonly 8-angled. Caudal peduncle 6-angled, covered with 8 to 12 longitudinal rows of imbricated radially striated plates. Anterior edge of each plate next in front of it, and plates spinous or not. Teeth small, even, in villiform bands on jaws, and in most species on vomer and palatines, sometimes wholly obsolete. Gills  $3\frac{1}{2}$ , no slit behind last. Gill-membranes united, free or joined to isthmus. Gill-rakers small. Pseudo-branchiæ large, extending down on inner side of opercle. Branchiostegal rays 6. Myodome with membranaceous roof. Basisphenoid absent. Post-temporal not bifurcate continuously, articulated with epiotic and pterotic. Pyloric cæca few, about 4 to 7. Vertebrae numerous, 35 to 50. Spinous dorsal large, small, or absent. Anal without spines. Caudal rounded, about 3 times as long as wide at base, with 10 to 12 long rays. Base of pectorals usually broad, lower rays sometimes produced. All rays of fins simple. Ventrals thoracic, narrow, their rays I, 2. Vent usually close behind ventrals.

Fishes of the cold seas, living among rocks and kelp, most of small size and fantastic form, and not valued as food. One species recorded from our coast.

Genus *ASPIDOPHOROIDES* Lacépède.

## The Sea Poachers.

*Aspidophoroides monopterygius* (Bloch).

Body very slender, the depth about 8, plates in lateral line 46 to 48, and nasal spines present.

A peculiar fish, reaching a length of 6 inches, in deep water. Once recorded by Dr. Abbott from off the north shore.



Sea Poacher. *Aspidophoroides monopterygius* (Bloch).

*Aspidophoroides monopterygius* Abbott, Geol. N. J., 1868, p. 816.

Family **CYCLOPTERIDÆ**.

## The Lump Suckers.

Body short and thick, more or less elevated. Head short and thick. Suborbital stay present, thin and flattish. Mouth small, terminal. Jaws with bands of slender simple teeth and none on vomer or palatines. Gill openings narrow, restricted to sides, and membranes broadly joined to isthmus and shoulder-girdle. Gills  $3\frac{1}{2}$ . Pseudobranchiæ present. Branchiostegals 6. Body covered with a thick skin which is smooth, tubercular or spinous. Pyloric cœca numerous. Intestine elongate. Vertebrae  $12 + 16$ . Skeleton feebly ossified. Dorsals 2, anterior part of flexible spines, which in adult are sometimes hidden by fleshy hump, again

wanting. Soft dorsal usually opposite anal and similar. Caudal rounded, free from dorsal and anal. Pectorals short, low, their bases broad and procurent. Ventrals thoracic, rudimentary, forming bony center of a sucking-disk.

Fishes of the northern seas, attaching themselves firmly to rocks and other objects by means of the adhesive ventral disk. They feed on worms, small fishes, crustacea and plants. One species on our coasts.

### Genus CYCLOPTERUS Linnæus.

#### The Lump Fishes.

#### *Cyclopterus lumpus* Linnæus.

PLATE 82.

#### Lump Fish.

Head 3; depth 2; D. XII-11; A. VII-10; P. 19; snout 3 in head; eye  $4\frac{1}{2}$ ; maxillary 3; interorbital space  $1\frac{5}{6}$ ; third dorsal ray 2; sixth anal ray  $1\frac{3}{4}$ ; least depth of caudal peduncle  $2\frac{4}{7}$ ; caudal  $1\frac{2}{3}$ ; pectoral  $1\frac{5}{6}$ . Body more or less compressed toward back, somewhat triangular in transverse section at first dorsal. Belly flattened, portion behind abdominal chamber compressed, and less than  $\frac{1}{2}$  length of body proper. Caudal peduncle compressed. Head short, subquadrangular in transverse section. Snout blunt, rounded. Eye rounded, high, anterior. Mouth anterior, opening slightly upward. Maxillary about  $\frac{2}{3}$  of snout. Teeth in bands, simple, small. Nostrils small, posterior smaller, near eye on interorbital space, anterior farther forward, half way to mouth and with short tube. Forehead bored, depressed, flattened. Gill-opening moderately wide. Disk moderately large, anterior below head. Skin thickly covered with small irregular subconical tubercles, sides of which are roughened with small conical protuberances. Larger longitudinal compressed tubercles form a vertical series from nape over first dorsal as spinous dorsal. A row of smaller ones from supraorbital region along flank to upper part of tail. A series starts a little above origin of

pectoral to lower side of tail, large anteriorly. A lower series starts along each side of lower surface from side of disk to anal. Fins rounded, radii rough with small tubercles. Rayed dorsal posterior, a little nearer base of caudal than gill-opening in its insertion. Anal a little posterior in its insertion to that of rayed dorsal. Caudal rounded. Pectoral rounded, broad and fringed. Color in life translucent greenish. Length 9 inches. New Jersey.

I have seen several examples from different points on our coast. It reaches a length of more than 20 inches, and is said to be rarely used as food. Dr. Henry C. Chapman secured an example at Atlantic City.

*Cyclopterus lumpus* Abbott, Geol. N. J., 1868, p. 818.

### Sub-Order CRANIOMI.

#### The Gurnards.

Singular fishes of warm seas, the head always with a coat of mail and differing from the *Parcioplita* in the peculiar shoulder-girdle.

#### *Key to the families.*

- a.* Pectoral with 3 lowest rays detached as feelers. TRIGLIDÆ  
*aa.* Pectoral divided to base into 2 unequal parts, but with no free feelers. CEPHALACANTHIDÆ

### Family TRIGLIDÆ.

#### The Gurnards.

Body elongate, usually more or less fusiform. Head externally bony, entirely cuirassed with rough bony plates, some of which are armed with spines. Eyes high. Mouth terminal or subinferior. Premaxillaries protractile. Maxillary without supplemental bone, slipping under preorbital. Teeth very small, in bands in jaws, and usually on vomer and palatines. Gill-membranes free from isthmus. Gills 4, a large slit behind fourth. Gill-rakers various. Pseudobranchiæ present. Air-vessel present. Pyloric cœca usually present, few in number. Body covered

with scales or bony plates. Spinous dorsal present, short. Soft dorsal similar to anal, which is without spines. Caudal narrow, few rayed. Pectoral large, with broad base, 3 lower rays detached, forming feelers, and used chiefly in search of food, as when turning over stones, exploring shells, etc. Ventrals thoracic, wide apart, separated by a flat area, and radii I, 5.

Singular fishes in all warm seas, some living about rocks, and others in deep water, where they are red in color. Two species on our coast.

### Genus PRIONOTUS Lacépède.

#### The Gurnards.

#### *Key to the species.*

- a. Maxillary small, 3 in head.  
 aa. Maxillary large, 2 to  $2\frac{3}{4}$  in head.

CAROLINUS  
 EVOLANS STRIGATUS

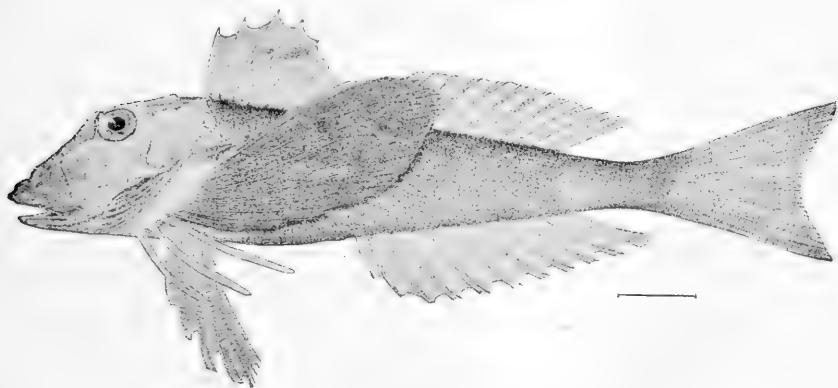
#### **Prionotus carolinus** (Linnæus)

Sea Robin. Pig Fish. Rock Pig Fish. Flying Fish. Spinous Gurnard.

Head 3; depth 5; D. X-13, 1; A. 12, 1; scales about 103 in a lateral series to base of caudal; pores 55 in lateral line to base of caudal and several more on latter; 7 scales between origin of rayed dorsal and lateral line; about 20 scales in a vertical series between origin of anal and lateral line; snout 2 in head; eye  $5\frac{3}{4}$ ; maxillary  $2\frac{9}{10}$ ; width of mouth  $2\frac{1}{2}$ ; interorbital space 7; preopercular spine  $6\frac{1}{2}$ ; third dorsal spine  $2\frac{1}{3}$ ; fourth dorsal ray  $2\frac{3}{5}$ ; third anal ray  $2\frac{7}{8}$ ; least depth of caudal peduncle 5; caudal  $1\frac{1}{5}$ ; ventral  $1\frac{1}{5}$ ; pectoral  $2\frac{7}{8}$  in head and trunk. Body slender. Head moderate. Snout long, depressed, truncate when viewed above with rounded edges. Eye a little elongate, high and a little posterior. Mouth broad, with bands of villiform teeth. Mandible inferior. Maxillary about three-fifths of space to orbit. Interorbital space rather narrow, concave. Bones of head comparatively smooth, preocular, post-



ocular, occipital and nuchal spines low depressed. Temporal ridge conspicuous, without spines. Lower edge of preopercle below spine with 2 spinules. A smaller spine at base of preopercular spine externally. Gill-rakers 12 v, lanceolate, rather short, and longest about equal to diameter of pupil. Scales on trunk uniform in size, except on breast, and out on base of caudal, where they are smaller. Spinous dorsal inserted about midway between gape of mouth and origin of rayed fin, third and fourth spines longest and anterior margin of first finely serrate. Rayed dorsal inserted about midway between gape of mouth and base of caudal, last rays highest. Anal similar, inserted a trifle posterior, and tips of radii free. Caudal emarginate, tip of upper



Rock Pig Fish. *Prionotus carolinus* (Linnæus).

lobe a little longer. Origin of pectoral opposite that of dorsal and fin extending a trifle behind base of sixth dorsal ray. Ventral inserted a little before origin of pectoral and reaching anal, margin of fin notched. Generally brown mottled with darker, especially fins. Spinous dorsal with a black ocellus superiorly between fourth and fifth spines. Back with 3 broad transverse dusky-brown bands, intermediate areas each with a narrower and paler band. Gill-membranes dusky. Pectoral blackish, its upper margin whitish. Anal with a median pale dusky longitudinal streak, lower margin whitish. Iris yellowish. Length about a foot. Sea Isle City.

Common on our coasts, though less frequently taken than the next. My examples from Beesley's Point, Atlantic City and Townsend's Inlet.

*Prionotus carolinus* Abbott, Geol. N. J., 1868, p. 817.—Moore, Bull. U. S. F. Com., XII, 1892, p. 364.

*Prionotus piliatus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 327.—Abbott, Geol. N. J., 1868, p. 817.

*Prionotus palmipes* Bean, Bull. U. S. F. Com., VII, 1887, p. 136.—Smith, Bull. U. S. F. Com., XII, 1892, p. 379.

***Prionotus evolans strigatus* (Cuvier).**

Sea Robin. Sand Pig Fish. Pig Fish. Flying Fish.



Sand Pig Fish. *Prionotus evolans strigatus* (Cuvier).

Head  $2\frac{4}{7}$ ; depth 4; A. X-12, 1; A. 11, 1; scales about 88 in a lateral series to base of caudal; pores 52 in lateral line to base of caudal, and several more on latter; 9 scales between origin of rayed dorsal and lateral line; 21 scales in a vertical series between origin of anal and lateral line; snout  $2\frac{1}{10}$  in head; eye  $6\frac{1}{3}$ ; maxillary  $2\frac{1}{6}$ ; interorbital space  $5\frac{1}{8}$ ; width of mouth  $2\frac{1}{2}$ ; third dorsal spine  $2\frac{1}{2}$ ; second dorsal ray  $2\frac{4}{5}$ ; ninth anal ray  $3\frac{1}{8}$ ; least depth of caudal peduncle  $5\frac{3}{4}$ ; caudal  $1\frac{2}{3}$ ; ventral  $1\frac{2}{7}$ ; pectoral  $2\frac{1}{8}$  in head and trunk. Body a little robust, comparatively deep. Head large. Snout long, convex, though broad, and when viewed above truncate in front with rounded edges. Eye a little elongate, high and a little posterior.

Mouth broad with bands of villiform teeth, broader above anteriorly, and none connected in front of either jaw. Mandible inferior. Maxillary reaching front of eye. Interorbital space a little broad and concave. Cheek-bone without distinct spine. Edge of preorbital granular-serrate, without distinct spine, and serræ about 12 on each side. Temporal ridges rough, without spines. Bones of head with coarsely granular striæ. Gill-rakers III 3 + 14 V, lanceolate, rather short, and longest about  $1\frac{1}{2}$  in orbit. Scales on trunk rather large, more or less of uniform size except much smaller on belly and breast. Base of caudal with small scales. Spinous dorsal inserted about midway between gape of mouth and origin of rayed fin, third spine longest and anterior margin of first finely serrate. Rayed dorsal inserted a little nearer base of caudal than gape of mouth, and highest anteriorly. Anal similar, inserted a trifle posterior, and tips of radii free. Caudal truncate. Origin of pectoral opposite that of spinous dorsal, and fin extending a little beyond base of ninth dorsal ray. Ventral inserted a little before origin of pectoral and reaching anal, margin of fin notched. Color brown. A dusky-bronze band below lateral line parallel with its course. Rayed dorsal with 2 dark blotches extending as bars on back. Head speckled. Lower surface of body white. A blackish blotch on spinous dorsal marginally at fourth and fifth spines. Pectoral dusky or blackish with numerous fine lines of dark, edges of fin above and below pale. Length less than a foot. Beesley's Point.

This is a most abundant species on our coast in shallow or deep water alike. Many examples from Cape May, Anglesea, Grassy Sound, Stone Harbor, Avalon, Sea Isle City, Absecom and Atlantic City.

*Prionotus strigatus* Bean, Bull. U. S. F. Com., VII, 1887, p. 136.—Moore, Bull. U. S. F. Com., XII, 1892, p. 364.—Smith, Bull. U. S. F. Com., XII, 1892, p. 378.

### Family CEPHALACANTHIDÆ.

#### The Flying Gurnards.

Body elongate, subquadrangular, tapering behind. Head very blunt, quadrangular, its surface almost entirely bony. Nasals,

preorbitals, suborbitals and bones on top of head united into a shield. Nuchal part of shield on each side produced backward in a bony ridge, ending in a strong spine reaching past front of dorsal. Preorbitals forming a projecting roof above jaws. Preopercle produced in a very long rough spine. Opercle smaller than eye. Interorbital space deeply concave. Mouth small, lower jaw included. Jaws with granular teeth. No teeth on vomer or palatines. Gill-openings narrow, vertical, separated by a very broad scaly isthmus. Gill-rakers minute. Pseudobranchiæ large. Air-vessel with 2 lateral parts, each with a large muscle. Pyloric cæca numerous. Vertebrae  $9 + 13 = 22$ . Scales bony, strongly keeled. At base of tail two serrated knife-like appendages. Cheeks and opercles with small scales. First dorsal of IV or V rather high flexible spines, first I or II spines nearly free from others. An immovable spine between dorsals. Anal and second dorsal short, of slender rays. Caudal lunate, small. Pectorals divided to base into 2 parts, anterior portion about as long as head, of about 6 closely connected rays, and posterior or larger portion more than twice length of head, reaching nearly to caudal in adult. These rays very slender, simple, wide apart at tip. Ventrals I, 4, bases close together, long and pointed, inner rays shortest.

Handsome and singular fishes of the warm seas. Remarkable for their powers of flight, which though like that of the true flying fishes is of shorter distance. One species on our coast.

### Genus CEPHALACANTHUS Lacépède.

#### The Flying Gurnards.

#### **Cephalacanthus volitans** (Linnæus).

PLATE 83.

#### Flying Robin.

Head  $3\frac{7}{8}$ ; depth 5; D. II, IV-I-8; A. VI-I, 20; P. VI-I, 18; scales about 62 in lateral series to base of caudal; snout  $2\frac{2}{3}$  in head; eye  $4\frac{1}{6}$ ; maxillary  $2\frac{7}{8}$ ; interorbital space

1 $\frac{3}{4}$ ; least depth of caudal peduncle 5 $\frac{2}{3}$ ; first dorsal ray 1 $\frac{2}{3}$ ; lower caudal lobe 1 $\frac{1}{3}$ ; ventral 1 $\frac{1}{8}$ . Head flattened above and below. Snout short, broadly obtuse and protruding. Eye large, high, and circular. Interorbital space broadly concave. Nostrils close together in front of eye, directed forwards. First two dorsal spines slightly connected by membrane at base. Of second spinous dorsal first spine longest. Margin of soft dorsal notched, and fin beginning well before anal. Caudal with upper lobe a little longer. Pectoral not quite reaching base of caudal. Ventral inserted before dorsal. Color olivaceous-brown above and marked with darker shades, below pale. Dorsals pale brownish, with as many as 5 broad blotches on each. Pectoral blackish, mottled with darker. Other fins pale. Length nearly 18 inches. Holly Beach.

It occurs off our coast at times and is said to be abundant.

*Dactylopterus volitans* Abbott, Geol. N. J., 1868, p. 817.

*Cephalacanthus volitans* Bean, Bull. U. S. F. Com., VII, 1887, p. 136.—Fowler, Science, XVII, April 10th, 1903, p. 595.

### Sub-Order GOBIODEI.

#### The Gobies.

These are small carnivorous bottom fishes, mostly in warm waters. A single family in our waters.

### Family GOBIIDÆ.

#### The Gobies.

Body elongate or oblong. Eyes usually moderate, sometimes concealed, and skin of head continuous with their covering. Dentition various, teeth generally small, sometimes developed into great canines. Premaxillaries protractile. Suborbital without bony stay. Opercle unarmed. Preopercle unarmed or with a short spine. Gill-membranes more or less united to isthmus, gill-openings thus restricted to sides. Gills 4, a slit behind fourth. Pseudobranchiæ present or absent. Usually no air-vessel. No

pyloric cæca. Body naked or covered with ctenoid or cycloid scales. No lateral line. Dorsals separate or connected, spinous fin short, of II to VIII flexible spines, or sometimes wanting. Anal usually with a single weak spine, fin similar to soft dorsal. Caudal convex. Ventrals close together, separate or united, each composed of a short spine and 3 or 4 soft rays, inner rays usually longest. Ventrals when united form a sucking-disk, a cross fold of skin at their base completing the cup.

Carnivorous fishes, mostly of small size, living on the bottom near the shore in warm regions. Some live in fresh water and others live indiscriminately in either fresh or salt water. Many are found buried in the mud of estuaries. Few are large enough to be of much value as food. One species on our coast.

#### Genus GOBIOSOMA Girard.

##### The Naked Gobies.

*Gobiosoma bosci* (Lacépède).

Goby. Variegated Goby.

Ventrals united, forming a disk free from belly, teeth simple, body and head entirely naked, usually VII dorsal spines, and no barbels.

I have no examples of this fish, which frequents the shallow grassy bays and inlets along our coast.

*Gobiosoma bosci* Bean, Bull. U. S. F. Com., VII, 1887, p. 136.  
—Moore, Bull. U. S. F. Com., XII, 1892, p. 363.

*Gobius alepidotus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 339.

*Gobiosoma alepidotum* Abbott, Geol. N. J., 1868, p. 817.

#### Sub-Order DISCOCEPHALI.

##### The Remoras.

A remarkable group consisting of a single family.

## Family ECHENEIDIDÆ.

## The Remoras.

Body fusiform, elongate. Mouth wide, with villiform teeth in jaws, on vomer, palatines and usually tongue. Premaxillaries not protractile. Lower jaw projecting beyond upper. Opercles unarmed. Gill-membranes not united, free from isthmus. Gills 4, a slit behind fourth. Gill-rakers short. Pseudobranchiæ obsolete. Branchiostegals 7. No air-vessel. Several pyloric appendages. Vertebrae more than  $10 + 14$ . Body covered with minute cycloid scales. Spinous dorsal modified into a sucking-disk placed on top of head and neck, and composed of a double series of transverse movable cartilaginous plates, serrated on their posterior or free edges. Dorsal and anal fins long, without spines, opposite each other. Caudal emarginate or rounded. Pectorals placed high. Ventrals I, 5, thoracic, close together. No caudal keel and finlets.

Fishes of moderate size, often found attached to sharks, or other large fishes and floating objects, by means of the dorsal disk, and are thus carried for great distances in the sea. Two species recorded from our coasts.

*Key to the genera.*

*a.* Body slender; ventrals narrowly adnate to abdomen.

ECHENEIS

*aa.* Body robust; ventrals broadly adnate to abdomen.

REMORA

## Genus ECHENEIS Linnæus.

## The Shark Suckers.

*Echeneis alba-cauda* Mitchill.

## PLATE 84.

Suck Fish. White Tailed Remora. Indian Remora.

Head  $4\frac{7}{8}$ ; depth  $8\frac{3}{5}$ ; D. 33; A. 34; laminae in disk 21; mandible  $2\frac{1}{10}$  in head; pectoral  $1\frac{1}{3}$ ; ventral  $1\frac{4}{5}$ ; third anal ray 2; caudal  $1\frac{4}{5}$ ; snout  $2\frac{1}{10}$  in head, measured from its own

tip; eye  $6\frac{1}{3}$ ; maxillary 3; interorbital space  $1\frac{2}{3}$ ; least depth of caudal peduncle 6. Body slender, elongate, depressed anteriorly, trunk tapering cylindrically to caudal fin. Head broadly depressed or flattened above with an elongate sucking-disk, its width  $2\frac{1}{2}$  in its length. Snout broad, depressed, profile when viewed above rounded. Eye circular, midway on side of head from tip of snout. Mouth a little oblique and mandible well protruded beyond tip of snout. Teeth uniform, rasp-like. Maxillary falling about an eye-diameter in advance of orbit. Gill-rakers  $3 + 9$ , lanceolate, longest 3 in orbit. Scales minute, so that surface of body has a coriaceous appearance. Dorsal inserted a little nearer base of caudal than tip of snout, anteriorly elevated but without lobe. Anal similar, inserted about opposite. Caudal a little convex, with upper and lower edges hardly produced. Pectoral half way to vent. Ventral inserted a little posterior to origin of pectoral and also half way to vent. Color brownish, belly dark like back. Side with a broad stripe of dusky-brown from snout to caudal, and edged with whitish. Caudal black, its outer angles whitish. Dorsal and anal broadly edged with whitish anteriorly. Pectoral and ventral blackish. Length about a foot. New Jersey.

I have many examples of this fish from our coast, where it is common at times. They are usually attached to large fishes, such as sharks, also large turtles, which they will leave at times if tempted with a baited hook. They are also attached without regard to species. One was taken at Long Beach.

*Echeneis albicauda* Abbott, Geol. N. J., 1868, p. 814.

*Echeneis naucrates* Moore, Bull. U. S. F. Com., XII, 1892, p. 360.

### Genus REMORA Gill.

#### The Remoras.

**Remora remora** (Linnæus).

#### Remora.

A stout-bodied species with 18 dorsal laminæ, and 23 rays in the soft dorsal.



It is known from our coast by Dr. Abbott's record. Reaching a length of 15 inches and found attached to large-sized sharks. I have no New Jersey examples.

*Echeneis remora* Abbott, Geol. N. J., 1868, p. 814.

### Sub-Order HETEROSOMATA.

#### The Flat Fishes.

A large group of fishes which are remarkable for their twisted cranium, the eyes and color on one side in the adult, while in the very young the two sides of the body are alike.

#### *Key to the families.*

- a. Preopercular margin more or less distinct, not hidden by skin and scales of head; eyes large, well separated; mouth moderate or large; teeth present. PLEURONECTIDÆ
- aa. Preopercular margin adnate, hidden by skin and scales of head; eyes small, close together; mouth very small, much twisted; teeth rudimentary or wanting. SOLEIDÆ

### Family PLEURONECTIDÆ.

#### The Flounders.

Body strongly compressed, oval, or elliptical in outline. Head unsymmetrical, cranium twisted. Both eyes on same side of body, which is horizontal in life, eyed side uppermost, and blind side lowermost and usually plain. In very young, bones of head symmetrical, 1 eye on each side, body vertical in water, mostly cranium becomes twisted, bringing eye over with it, eyes large, well separated. Mouth small or large, dentition various, and teeth always present. Premaxillaries protractile. No supplemental maxillary. Preopercle with its margin usually distinct, not wholly adnate or hidden by skin of head. Gills 4, a slit behind fourth. Pseudobranchiæ present. Lower pharyngeals separate. No air-vessel. Viscera confined to anterior part of body. Vent not far behind head. Scales various, rarely absent. Mostly cranium becomes twisted, bringing eye over with it. Eyes

usually small. Lateral line usually present, extending on caudal, sometimes duplicated or wanting. Dorsal long, continuous, of soft rays only, beginning on head. Anal similar, shorter. Caudal various, sometimes coalescent with dorsal and anal. Pectorals inserted rather high, rarely wanting. Ventrals under pectorals, usually of several soft rays, one of them sometimes wanting.

Fishes of the sand bottoms of all seas, some ascending rivers, and carnivorous. Many are important food-fishes.

*Key to the genera.*

a. BOTHINÆ. Ventrals unsymmetrical, dissimilar in position and usually in form, ventral of eyed side being extended along ridge of abdomen; eyes and color on left side.

b. Lateral line with distinct arch in front, vomer with teeth.

LOPHOPSETTA

bb. Lateral line without arch in front, vomer toothless.

ETROPUS

aa. Ventrals symmetrical, similar in position and in form of base, ventral of colored side not extending along ridge of abdomen.

c. HIPPOGLOSSINÆ. Mouth nearly symmetrical, dentition nearly equally developed on both sides; gape usually, but not always, wide.

d. Body comparatively elongate; caudal lunate; dorsal rays 100; anal 85.

HIPPOGLOSSUS

dd. Body broader; caudal double truncate or rounded; dorsal rays fewer than 95; anal fewer than 75.

PARALICHTHYS

cc. PLEURONECTINÆ. Mouth unsymmetrical, jaws on eye side with nearly straight outline, bones on blind side strongly curved; teeth chiefly on blind side.

e. Lateral line with a distinct arch in front; scales imbricated, rough ctenoid.

LIMANDA

ee. Lateral line without distinct arch in front, scales regularly imbricated, all on eyed side ctenoid in both sexes.

PSEUDOPLEURONECTES

Genus *LOPHOPSETTA* Gill.

The Window Panes.

*Lophopsetta maculata* (Mitchill).

PLATE 85.

Window Light. Spotted Turbot. Sole. Spotted Flounder.  
Sand Flounder.

Head  $3\frac{1}{2}$ ; depth  $1\frac{1}{2}$ ; D. 65; A. 50; V. 6; scales 100 above course of lateral line to base of caudal; mandible 2 in head;

longest dorsal ray  $1\frac{2}{3}$ ; longest anal ray  $1\frac{3}{5}$ ; least depth of caudal peduncle  $2\frac{1}{6}$ ; caudal 1; pectoral  $1\frac{4}{7}$ ; snout  $3\frac{1}{2}$  in head, measured from tip of upper jaw; eye  $4\frac{1}{2}$ ; maxillary  $2\frac{1}{3}$ ; interorbital space 6. Body broadly rhomboid, strongly compressed and translucent in life. Head small. Snout obtuse. Eye a little elongate, anterior, lower and little in advance of upper. Mouth large, maxillary, reaching anterior margin of pupil of lower orbit, and its distal expansion  $1\frac{2}{3}$  in same, also with a bony tubercle on its anterior end. Mandible projecting and with a knob protruding from symphysis. Jaws with uniserial teeth, in a very narrow band in front. Interorbital space flattened. Gill-rakers  $8 + 23$ , slender, longest  $1\frac{3}{4}$  in orbit. Scales small, cycloid, and imbricated in skin. Lateral line strongly arched in front, curved part  $2\frac{1}{2}$  in straight part. Maxillary, mandible, snout and greater part of interorbital space naked. Scales on blind side a little smaller than those on colored side. Anterior dorsal rays produced, ends branched and free, first near tip of snout, and those at posterior third of fin highest. Origin of anal directly below angle of preopercle, fin highest a little behind middle of its length, or opposite corresponding part of dorsal. Ventral basis long, that of colored side extending along ridge of body from notch in isthmus to front of anal, base of ventral on blind side shorter. Caudal long, rounded. Pectoral reaching past curve on colored side, its mate  $1\frac{1}{3}$  in its length. Color almost translucent light olive, variegated with many small dark spots. Vertical fins with large nebulous blotches or spots of dusky or blackish. Pectoral on colored side speckled, other plain colored. Length  $10\frac{1}{4}$  inches. Sea Isle City.

A small thin flounder, notable for its translucent appearance, rarely exceeding 2 pounds, and not highly valued as a food-fish. On our coast it is abundant. Many examples have been taken at Cape May, Anglesea, Stone Harbor, Beesley's Point and Atlantic City. Mr. Wm. J. Fox found the young at Sea Isle City in August of 1905.

*Rhombus maculatus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 350.

*Sophopsetta maculata* Abbott, Geol. N. J., 1868, p. 819, evidently lapsus for *Lophopsetta*.

*Lophopsetta maculata* Verrill, Am. Nat., 1, 1871, p. 399.

*Bothus maculatus* Bean, Bull. U. S. F. Com., VII, 1887, p. 135.

*Pleuronectes maculatus* Moore, Bull. U. S. F. Com., XII, 1892, p. 363.

## Genus ETROPUS Jordan and Gilbert.

### The Little Flounders.

#### *Etropus microstomus* (Gill).

Head 5, in total; depth  $2\frac{2}{3}$ , in total; D. 81; A. 58; C. 4, 6, 5, 3; P. 10; V. 6; scales about 42 in lateral line, 10 above and 14 below; snout scarcely 7 in head; eye about  $3\frac{3}{5}$ ; upper jaw 4; mandible  $2\frac{1}{2}$ ; fortieth dorsal ray 10 in total length; caudal 6; colored pectoral  $6\frac{2}{3}$ ; pale pectoral 10; colored ventral 14; pale ventral less than 12; caudal peduncle about 11. Head rather abbreviated, scarcely sinuous above eyes, blunt at snout. Rostral area rhombic, not higher than long. Eyes even. Mouth rather small. Teeth very small, close together, larger in front. Scales large, angular behind, covered with smaller ones, especially near point of junction of contiguous ones, where alone they are developed on blind side. Scales of eyed side mostly minutely ciliated behind, unarmed, however, near lateral line, and scales of last quadrate and mostly covered. Scales of blind side less angular behind and unarmed. Dorsal commences above front rim of orbit, and highest and convergent near fortieth ray. Anal highest at about twenty-fifth ray, and as high, or even higher than dorsal. Caudal rounded behind. Pectorals unequally developed, that of dark side prolonged, while that of white side only equals a tenth of same, rays all simple. Ventrals also unequally developed, right on abdominal ridge at its origin, rather in advance of opercular margin and stretched backwards, extending to second anal ray. Ventral on white side more advanced, wider, rays longer, and extending backward near third anal ray. Color uniform reddish-brown. Little more than 3 inches. Beesley's Point.

(Gill.)

I have no examples of this species, which does not exceed several inches.

*Citharichthys microstomus* Gill, Proc. Acad. Nat. Sci. Phila., 1864, p. 223.—Abbott, Geol. N. J., 1868, p. 820.—Bean, Bull. U. S. F. Com., VII, 1887, p. 135.

*Etropus microstomus* Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, III, 1898, p. 2687.

### Genus HIPPOGLOSSUS Cuvier.

#### The Halibut.

**Hippoglossus hippoglossus** (Linnæus).

PLATE 86.

Halibut.

This may be distinguished from our other species principally by means of its emarginate caudal.

I have never seen any New Jersey examples. It is a most important food-fish, of excellent quality, and sometimes reaches a weight of 400 pounds. An inhabitant of northern seas, occasionally south to Sandy Hook. It is said to be taken on hook and line on all cod banks.

*Hippoglossus americanus* Abbott, Geol. N. J., 1868, p. 819.

### Genus PARALICHTHYS Girard.

#### The Summer Flounders.

**Paralichthys dentatus** (Linnæus).

PLATE 87.

Summer Flounder. Flounder. Fluke. Splaice. Oblong Flounder. Long Toothed Flounder.

Head  $3\frac{2}{5}$ ; depth  $2\frac{3}{5}$ ; D. 87; A. 68; about 105 series of scales just above lateral line from gill-opening to base of caudal; 38 scales in a vertical series from highest point of back to lateral line, and about same number continued down to lowest point of

lower profile; mandible  $1\frac{2}{3}$  in head; highest dorsal ray 3; highest anal ray  $2\frac{7}{8}$ ; caudal  $1\frac{1}{2}$ ; least depth of caudal peduncle 3; pectoral  $2\frac{1}{3}$ ; ventral 4; snout 4 in head, measured from tip of upper jaw; eye  $7\frac{1}{3}$ ; maxillary  $2\frac{1}{10}$ ; interorbital space  $10\frac{1}{2}$ . Body oblong, and greatest depth falling about midway in length. Caudal peduncle deep, well compressed. Head rather large, and profiles of muzzle when closed about forming a right angle, lower obliquely vertical. Snout short. Eye ellipsoid, placed a little before first third in head, and lower but little in advance of upper. Mouth large, oblique, and gape a little curved. Lips rather fleshy. Mandible protruding. Maxillary reaching posterior margin of pupil of lower eye, and its distal expansion about equal to horizontal orbital diameter. Teeth large, conic, canine-like and wide-set in front of jaws, becoming reduced posteriorly more especially above. Interorbital space narrow and flattened. Gill-rakers  $4 + 15$ , rather long and slender, longest about  $\frac{7}{8}$  of horizontal orbital diameter. Scales cycloid, mostly with numerous smaller accessory scales. Maxillary scaly above. Lateral line arched for about first fourth of its course from gill-opening. Origin of dorsal inserted about opposite anterior margin of lower orbit and tips of radii free anteriorly. Anal begins a trifle before origin of pectoral, and margin of fin a little notched. Posterior margin of caudal convex. Pectoral short and rather broad. Ventral inserted about midway between posterior margin of upper orbit and origin of pectoral, and reaching base of second anal ray. Color light olive-brown sinistrally, variegated with darker and lighter shades. Length 20 inches. Beesley's Point.

Color when fresh drab-brown, much lighter and variegated when alive. Pattern of coloration also apparently subject to infinite variation in diffuse mottlings or cloudings. Fins all paler, especially basally, and also mottled and becoming dilute brownish at tip of each ray. Sinistral or dark side with numerous variable ocelli of dark brownish or dusky. In some examples they are more numerous than others, also of variable density of color. Head in some examples finely specked with dusky or deep brownish, also fins. In others caudal with more or less dull rosy tints. Still other examples were entirely paler and others

darker. Left ventral brownish and with its radii finely specked with a little darker like those of pectoral, though its inner basal region paler. Ventral pale or white like right surface of body. Right surface of caudal becoming darker distally, usually a livid pale brown. Iris pale brown, a narrow rim around pupil of dull old-gold. Upper surface of eye specked brownish. Inside of mouth whitish. Left sides of dorsal and anal similar to caudal though usually more whitish. Two examples, larger about 23 inches long. Sea Isle City, October 15th, 1905, Wm. J. Fox.

The most important flounder on our coast as a food-fish, reaching a length of 3 feet and a weight of 15 pounds. I have examined many examples from Cape May, Wildwood, Holly Beach, Anglesea, Grassy Sound, Stone Harbor, Ocean City, Beesley's Point, Barnegat Pier and Atlantic City, where it is abundant all summer and the object of sport to nearly all visiting anglers of the south Jersey shores. Frequently on a good tide as many as several dozen are taken during a day.

*Paralichthys dentatus* Bean, Bull. U. S. F. Com., VII, 1887, p. 135.—Moore, Bull. U. S. F. Com., XII, 1892, p. 363.—Smith, Bull. U. S. F. Com., XII, 1892, p. 379.

*Platessa ocellaris* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 349.

*Chanopsetta ocellaris* Abbott, Geol. N. J., 1868, p. 819.—Verrill, Am. Nat., I, 1871, p. 399.

#### Genus LIMANDA Gottsche.

#### The Mud Dabs.

#### *Limanda ferruginea* (Storer).

PLATE 88.

#### Fluke.

Among the true flounders this species may be distinguished by the arch anteriorly in the lateral line.

I have never seen any New Jersey examples.

*Myzopsetta ferruginea* Abbott, Geol. N. J., 1868, p. 819.

Genus PSEUDOPLEURONECTES Bleeker.

The Winter Flounders.

**Pseudopleuronectes americanus** (Walbaum).

PLATE 89.

Flat Fish. Flounder. Winter Flounder. New York Flat Fish.

The lateral line is not arched.

Although I have no New Jersey examples this fish is frequently brought from various points along the New Jersey coast and offered for sale in the markets of Philadelphia during cold weather. It is a good food-fish, reaching a length of 15 inches and a weight of about 2 pounds.

*Pseudopleuronectes americanus* Abbott, Geol. N. J., 1868, p. 819.—Smith, Bull. U. S. F. Com., XII, 1892, p. 380.

*Pleuronectes americanus* Bean, Bull. U. S. F. Com., VII, 1887, p. 135.

*Platessa plana* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 349.

Family SOLEIDÆ.

The Soles.

Body oblong or elongate. Eyes small, close together, with or without a bony ridge between them. Mouth very small, much twisted toward eyed side. Teeth in villiform bands, very small or obsolete. Edge of preopercle adnate, concealed by skin and scales. Gill-membranes adnate to shoulder-girdle above. Gill-openings narrow. Body usually scaly. Pectorals small or wanting. Ventrals small, 1 or both sometimes wanting.

Small fishes of sandy bottoms, and those of sufficient size valued as food. A single species along our shores.



Genus *ACHIRUS* Lacépède.

## The American Soles.

*Achirus fasciatus* Lacépède.

## PLATE 90.

Sole. Hog Choker. New York Sole. Cover Clip.

Head  $3\frac{3}{4}$ ; depth  $1\frac{1}{5}$ ; D. 55; A. 41; scales 75 in lateral line to base of caudal, and 7 more on latter; 32 scales between base of dorsal at its highest part and lateral line, counted in a vertical series; 42 scales between lateral line and lowest portion of base of anal counted in a vertical series; snout  $2\frac{1}{8}$  in head, measured from lower orbit; mouth  $3\frac{1}{6}$ ; highest dorsal ray  $1\frac{3}{5}$ ; highest anal ray  $1\frac{3}{5}$ ; caudal 1. Body dextral, broad, regularly elliptical. Head rather small. Snout a little long. Eye circular, upper well in advance of lower, or its posterior margin about opposite anterior margin of lower pupil. Mouth curved, gape reaching about opposite front rim of pupil. Lower right lip fringed, upper more papillose. Teeth minute, in asperous bands most developed on blind side, where gape of mouth is also more curved. Nostril large, close to lip, just in front of margin of anterior eye. A well-developed prenasal spine, though rather short. Interorbital space about  $\frac{3}{4}$  of orbit. Gill-opening about twice length of maxillary. Gill-rakers short weak fleshy tubercles, rather sparse. Body covered with strongly ctenoid scales, those along anterior dorsal profile enlarged. Interorbital space scaly. Bases of all fins covered with small scales. Lateral line nearly straight. Dorsal beginning on tip of snout, last rays decreasing rapidly, giving fin a truncated appearance posteriorly. Anal similar. Caudal rounded. No pectorals. Color dusky-olive dextrally, more or less finely mottled and with about 8 dark vertical lines. Dorsal and anal with membrane of every second or third pair of rays blackish, besides dark cloudings at base of fin. Caudal with dark blotches basally. Left or blind side whitish. Length  $5\frac{1}{8}$  inches. Beesley's Point.

Abundant along our sea-coast and ascending tide-water streams. It has several times been noted in the Delaware tide-

water, and Dr. Charles C. Abbott tells me it has been taken on a hook and line at Trenton. It is most too small to be of any value as a food-fish. At Cape May and other points along our coast it is known as hog choker, for the reason that it bends up and resists the attempt of the hog to swallow it. This is further augmented by the nature of the scales and small bones sticking in the devourer's teeth and gullet. I have a small example taken from the gullet of a fish duck (*Merganser americanus*), which was killed near Atlantic City several years ago. My examples from Cape May, Sea Isle City and Atlantic City.

*Achirus fasciatus* Moore, Bull. U. S. F. Com., XII, 1892, p. 363.—E. Smith, Trans. Linn. Soc. N. Y., IX, 1897, p. 49.

*Achirus mollis* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 350.—Bean, Bull U. S. F. Com., VII, 1887, p. 134.

*Grammichthys lineatus* Abbott, Geol. N. J., 1868, p. 820.

### Sub-Order JUGULARES.

#### The Jugular Fishes.

These, together with the next sub-order, include forms with jugular ventrals among spiny-rayed fishes.

#### Key to the families.

- a. Fin-spines present.
  - b. Head cuboid; mouth almost vertical; lips fringed. URANOSCOPIDÆ
  - bb. Head compressed; mouth inclined or low; lips rarely fringed.
    - c. Teeth not developed as coarse molars. BLENNIIDÆ
    - cc. Teeth developed as coarse molars on vomer, palatines and sides of mandible. ANARHICHADIDÆ
- aa. No fin-spines.
  - d. Vertical fins confluent with caudal.
    - e. Ventrals jugular, well behind eye, never filamentous. ZOARCIDÆ
    - ee. Ventrals developed as slender filaments on throat close under eye. OPHIDIIDÆ
  - dd. Caudal distinct from vertical fins. AMMODYTIDÆ

### Family URANOSCOPIDÆ.

#### The Star Gazers.

Body elongate, conic, subcompressed, widest and deepest at occiput. Head large, broad. Eyes small, on anterior and upper

portion of head, with vertical rings. Mouth vertical, with strong and prominent mandible. Premaxillaries freely protractile. Maxillary broad, without supplemental bones, not slipping under preorbital. Teeth moderate on jaws, vomer and palatines. Gill-openings wide, continued forward. Gill-membranes nearly separate, free from isthmus. Gills  $3\frac{1}{2}$ , a slit behind last. Pseudo-branchiæ present. Branchiostegals 6. Air-vessel generally absent. Pyloric cæca in moderate number. Vertebrae 24 to 26. Body either naked or covered with very small smooth adherent scales which are arranged in very oblique series running downward and backward. Scales on belly inconspicuous or obsolete. Head covered with bony plates. Lateral line little developed, running high. Spinous dorsal very short or wanting. Second dorsal long. Anal and pectorals large, latter with broad oblique bases, lower rays rapidly shortened and most of them branched. Ventrals I, 5, jugular, close together, spine very short and innermost ray longest. Caudal not forked.

Carnivorous fishes living on bottom of shores of most warm regions.

### Genus ASTROSCOPUS Brevoort.

#### Electric Star Gazers.

#### *Key to the genera.*

- a. Naked space between forks of Y on top of head long and narrow, but shorter than vertical limb of Y; no distinct spines before eye; sides with round pale spots, each with a dark ring. Y-GRÆCUM
- aa. Naked space between forks of Y short and broad, but longer than very short vertical limb of Y; 2 distinct spines directed forward before eye; sides with small pale spots, not dark-edged. GUTTATUS

#### *Astroscopeus y-græcum* (Cuvier).

PLATE 91.

#### Star Gazer.

Head  $2\frac{2}{5}$ ; depth 3; D. IV, 14; A. 13; width of head  $1\frac{1}{3}$  in its length; depth of head  $1\frac{3}{5}$ ; upper edge of pectoral  $1\frac{1}{3}$ ; sixth dorsal ray  $2\frac{3}{5}$ ; eleventh anal ray  $3\frac{1}{6}$ ; caudal  $1\frac{3}{7}$ ; least depth of caudal peduncle  $3\frac{4}{5}$ ; innermost ventral ray 2; interorbital space

3½; maxillary 2½; eye 4½ in interorbital space. Body robust forward, moderately elongate, and greatest depth at occiput, anteriorly subcylindrical and posteriorly somewhat compressed. Head large and broad. Eye small, circular. Maxillary oblique, its greatest expansion 3 in orbit. Lips with many transverse filament-like plications. Teeth conical, small and movable, in many bands in upper jaw, in lower teeth larger and in fewer bands. Teeth on vomer and palatines. Naked space between forks of Y on top of head long and narrow, but shorter than vertical limb of Y. Naked area behind eye broad. Anterior internasal space a little greater than posterior. Nostrils with short cutaneous flaps marginally, and posterior pair each with an outwardly curved canal with entire margins furnished similarly. Two spinous tubercles directed forward from front of orbit. Bones of head rugosely striate, greater portion of opercle superiorly especially so. Gill-rakers obsolete asperities. Scales very small, somewhat imbedded, disappearing on under surface of body, or from below a line drawn from fifth anal ray to upper end of base of pectoral. Lateral line not evident. Second dorsal spine longest, and inserted a little behind origin of pectoral. Median portion of rayed dorsal highest. Anal begins opposite origin of rayed dorsal, lower and longer, and tips of radii a little free. Caudal rounded. Pectoral with upper rays longer and reaching a little beyond anal. Ventral 1½ to anal. Color deep brown above, whitish below. Upper parts dotted with white, margined with blackish around each one, and these all becoming larger below rayed dorsal. Spinous dorsal black, whitish posteriorly. Rayed dorsal whitish with oblique dusky or blackish bands. Anal whitish with a longitudinal blackish median band. Caudal whitish with a broad median and submarginal band above and below of blackish. Pectorals dusky. Ventrals white with dusky tints. Length 14 inches. Atlantic City.

I have but a single example, described above, and received from Prof. Henry C. Chapman. This fish occurs in sandy bays of shallow water and varies much with age. It reaches a length of 15 inches and the naked area on top of the head has been stated to be the seat of electric power.

*Upsilononphorus anoplos* Abbott, Geol. N. J., 1868, p. 817.

*Astroscopus guttatus* (Abbott).

## Star Gazer.

Head  $2\frac{2}{3}$ ; depth  $3\frac{1}{3}$ ; D. IV, 15; A. 13; width of head  $1\frac{1}{3}$  in its length; depth of head  $1\frac{3}{5}$ ; upper edge of pectoral  $1\frac{3}{7}$ ; eighth dorsal ray  $2\frac{1}{3}$ ; eleventh anal ray 3; caudal  $1\frac{4}{7}$ ; least depth of caudal peduncle 4; innermost ventral ray  $1\frac{3}{4}$ ; inter-orbital space about 3 over head measured from tip of upper jaw; maxillary  $2\frac{2}{5}$ ; eye  $3\frac{1}{2}$  in head. Body robust. Head broad, well flattened above. Snout broad, flattened. Eye small, a little longer than broad. Maxillary vertical, its greatest expansion half of interorbital space. Lips with many transverse filament-like plications. Teeth rather large, unequal. Naked space between forks of Y on top of head short and broad, longer than vertical limb of Y, which is very short. Naked area behind eye broad, its greatest width  $1\frac{3}{4}$  in its greatest length. Anterior internasal space a little greater than posterior. Nostrils with short cutaneous flaps marginally, and posterior pair each with an outwardly curved canal with entire margins furnished similarly. Two short spines directed forward from front of orbit. Bones of head more or less rugosely striate, opercles becoming striate marginally. Preopercle with 2 blunt spines directed downwards. Gill-rakers reduced to small asperities. Scales disappearing on lower surface of body. Lateral line extending superiorly from shoulder to spinous dorsal, then continued close along bases of both dorsals. First 2 dorsal spines larger, subequal. Posterior portion of rayed dorsal highest. Anal begins behind rayed dorsal, and tips of radii free. Caudal rounded. Pectoral with upper rays longer, reaches beyond anal. Ventral a little more than half way to vent. Color above, and lower jaw, bright chocolate. Belly and throat white. Darker parts marked with many circular spots lighter than ground-color. Membrane of first dorsal black. Second dorsal white with 3 irregular bands of dull black obliquely across. Caudal with 3 parallel bands of blackish-brown, middle appearing as continuation of variable longitudinal band on center of side. Anal has variable band of

dull brown, darker on posterior termination. Length  $6\frac{1}{2}$  inches. Type of *Uranoscopus guttatus* Abbott. Cape May.

This is the only example examined. The species is apparently rare. It is said to attain a foot in length.

*Uranoscopus guttatus* Abbott, Proc. Acad. Nat. Sci., Phila., 1860, p. 365, Pl. 7.—Abbott, l. c., p. 479, a correction.

*Upsilonphorus guttatus* Abbott, Geol. N. J., 1868, p. 817.

*Astroscopus anoplus* Bean, Bull. U. S. F. Com., VII, 1887, p. 136, Pl. 1, figs. 1-2.

### Family BLENNIIDÆ.

#### The Blennies.

Body oblong or elongate. Mouth large or small, teeth various. Gill-membranes free from isthmus or more or less attached to it. Pseudobranchiæ present. Vertebrae in moderate or large number, 30 to 80. Hypercoracoid perforate, shoulder-girdle normally formed. Suborbital without bony stay. Body naked or covered with moderate or small scales which are ctenoid or cycloid. Lateral line variously developed, often wanting and often duplicated. Dorsal fin with spines anteriorly, with or without soft rays. Anal long, similar to rayed dorsal. Caudal well developed. Ventrals jugular, or subthoracic, of 1 spine and 1 to 3 soft rays, often wanting.

Mostly carnivorous fishes of small or moderate size, living near the shore in tropical, temperate and Arctic seas. Excepting for the ovoviviparous *Clinina* they are considered viviparous. Several species rarely on our shores.

#### Key to the genera.

a. Teeth comb-like; soft rays forming about half of dorsal.

b. Gill-membranes free from isthmus, or at least forming a distinct fold across; one or both jaws with a posterior fang-like canine.

BLENNIUS

bb. Gill-membranes broadly united to isthmus, gill-openings restricted to sides; one or both jaws, with a posterior fang-like canine.

HYPLEUROCHILUS

aa. Teeth conic, not comb-like; dorsal of spines only.

PHOLIS

Genus *BLENNIUS* Linnæus.

## The Blennies.

*Blennius fucorum* Valenciennes.

## Blenny.

Distinguished from the next principally by the gill-membranes, which are free from the isthmus posteriorly.

This included on Dr. Abbott's reference. It is, however, if a member of our fauna at all, to be found in the open sea in floating seaweed as a straggler. I have never seen any examples.

*Blennius fucorum* Abbott, Geol. N. J., 1868, p. 817.

Genus *HYPLEUROCHILUS* Gill.

## The Shell Blennies.

*Hypleurochilus geminatus* (Wood).

Head  $3\frac{1}{3}$ ; depth  $3\frac{1}{3}$ ; D. XI, 15; A. 18; snout  $3\frac{1}{8}$  in head; eye  $3\frac{1}{8}$ ; maxillary  $3\frac{1}{8}$ ; fifth dorsal spine 2; fifth dorsal ray  $1\frac{2}{3}$ ; fifteenth anal ray 2; caudal  $1\frac{1}{3}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ . Body elongately ovoid, well compressed, abdominal region swollen, and tapering well from origin of anal. Head well compressed, not very blunt, and upper profile obtuse with angle forming over orbit. Snout oblique, surface convex. Eye circular, anterior and high. Teeth small, uniserial, compressed. A strong backwardly-hooked canine on each side of upper jaw posteriorly. Mouth a little inclined forwards. Jaws nearly even. Lips broad and somewhat fleshy laterally. Maxillary reaching about middle of orbit. Interorbital space narrowly concave. Gill-openings lateral, membranes widely joined over isthmus. Lateral line with about 15 tubes in its straight part, which ends about opposite tip of pectoral. A supraocular cirrus a little less than orbit, and with 4 small tentacles basally. Spinous dorsal inserted a little behind base of ventral, and spines a little higher medianly. Rayed dorsal inserted nearly midway between posterior margin

of pupil and base of caudal, higher anteriorly. Anal inserted a little in advance of rayed dorsal, its margin notched and tips of radii free. Caudal a little rounded. Pectoral broad, reaching vent. Ventral inserted nearly midway between front rim of orbit and origin of pectoral. Brownish, faintly barred darker. Vertical fins dark-edged, and spinous dorsal dusky or blackish in front. Length  $2\frac{3}{8}$  inches. Beesley's Point.

This little fish is only known to me from our coast by the above-described example, which was taken many years ago by Samuel Ashmead. It is said to be abundant further south than our shores in shallow water, in empty shells, and clusters of tunicates. The sexes are unlike, the male being distinguished by the high suborbital crest.

#### Genus PHOLIS Walbaum.

#### The Gunnells.

#### *Pholis gunnellus* (Linnæus).

#### PLATE 92.

#### Gunnell. Butter Fish.

This species may be known by its long, compressed, band-shaped body, uniserial blunt teeth, and the dorsal fin being composed entirely of many spines.

I have never seen any New Jersey examples, though it has been recorded as far south on our shores as Delaware Bay by Dr. Abbott. It reaches a length of a foot, and occurs mostly on rocky shores among algæ.

*Muraenoides mucronatus* Abbott, Geol. N. J., 1868, p. 818.

#### Family ANARHICHADIDÆ.

#### The Wolf Fishes.

Body oblong or elongate. Bones very thick and strong, profile strongly decurved. Mouth very large, oblique, jaws anteriorly, with very strong conical canines. Sides of lower jaw with very



strong molar teeth, which shut against a series of very coarse molars on palatines. Vomer solid, armed with strong molar teeth, dentition adapted for crushing sea-urchins and mollusks. Gill-membranes broadly united to isthmus. No pyloric cœca. Body covered with rudimentary scales. Head scaleless, without cirri. No lateral line. Dorsal fin high, composed entirely of flexible spines. Pectoral fins broad, placed low. No ventral fins.

Large carnivorous fishes of northern seas.

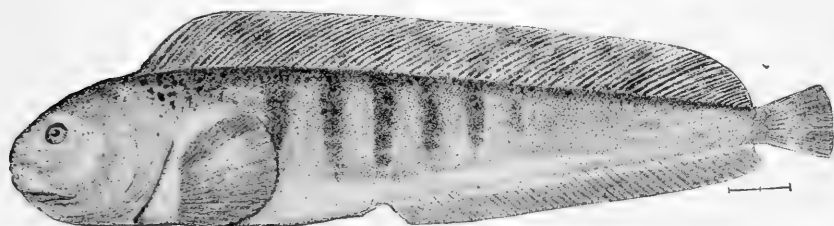
Genus *ANARHICHAS* Linnæus.

The Wolf Fishes.

*Anarhichas lupus* Linnæus.

Wolf Fish.

Distinguished by its heavy, powerful muzzle, the vomerine



Wolf Fish. *Anarhichas lupus* Linnæus.

teeth extending much farther back than short band of palatine teeth, and fewer radii in vertical fins.

I have never seen any New Jersey examples of this large voracious fish. It is not valued as food, and reaches 4 feet in length. It is included on Dr. Abbott reference.

*Anarrhicas lupus* Abbott, Geol. N. J., 1868, p. 818.

Family **ZOARCIDÆ**.

The Eel Pouts.

Body elongate, more or less eel-shaped. Head large, bones unarmed. Mouth large, with conical teeth in jaws, and some-

times on vomer and palatines. Gill-membranes broadly united to isthmus. Gill-opening reduced to a vertical slit. Gills 4, a slit behind fourth. Gill-rakers small. Pseudobranchiæ present. Pyloric cœca rudimentary. Body naked or covered with very small imbedded cycloid scales. Lateral line obsolete or little developed, sometimes bent downwards behind pectorals, sometimes sending a branch on median line backward. Dorsal and anal fins very long, of soft rays only, or dorsal with a few spines in its posterior portion. Vertical fins sometimes confluent around tail. Pectorals small. Ventrals jugular, very small or wanting, if present inserted behind eye. Vent not near head.

Bottom fishes chiefly of the Arctic and Antarctic seas, some viviparous and descending to considerable depths.

### Genus ZOARCES Cuvier.

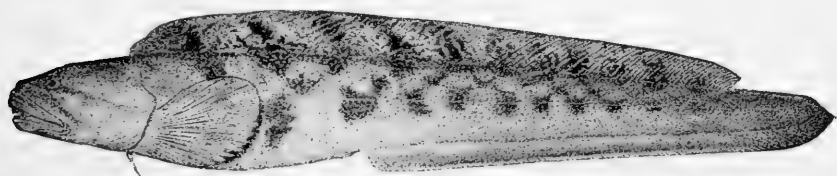
#### The Eel Pouts.

#### *Zoarces anguillaris* (Peck).

#### Eel Pout. Conger Eel Pout.

Head  $5\frac{1}{4}$ ; depth 8; D. 93, XIX, 24; A. 112; snout 3 in head; eye  $7\frac{1}{4}$ ; maxillary  $1\frac{4}{5}$ ; interorbital space 6; pectoral  $1\frac{4}{5}$ ; ventral  $6\frac{1}{6}$ ; width of mouth  $2\frac{7}{8}$ ; twelfth dorsal ray  $3\frac{3}{4}$ ; sixth anal ray  $5\frac{1}{4}$ . Body long, slender, compressed, and tapering posteriorly. Head robust, heavy, large, becoming narrow above, and upper profile convex from orbit. Snout rather long, broadly convex. Eye elongate, high, anterior. Mouth large, mandible inferior, and lips very thick and fleshy. Maxillary reaching a little beyond orbit. Teeth in jaws biserial in front, uniserial laterally, strong, conic, blunt, and those in outer series a little enlarged. No vomerine or palatine teeth. Interorbital space narrow, slightly convex. Gill-rakers 5 + 10 short asperous tubercles. Scales small, circular, rather far apart and imbedded in skin. Lateral line of fine pores, midway in depth of fish. Origin of dorsal about opposite posterior margin of preopercle, covered with thick skin and decreasing in height posteriorly. Spinous

dorsal low, beginning about last seventh in length of head and trunk, and rayed dorsal posterior to it confluent with anal by means of a short pointed caudal. Anal similar to first dorsal, and beginning about first third in space between posterior margin of orbit and base of caudal. Pectorals broadly expanded, rounded, and reaching about half way to anal. Ventral short, inserted just behind origin of first dorsal. Color livid deep gray-brown, becoming paler or whitish on under surface of body and anal. Back also mottled or clouded obscurely with a deeper brownish shade than general body-color. Dorsal with about 3 obscure submarginal dull dusky lines longitudinally. Anal with grayish basally in front, margin becoming white. Pectorals whitish mostly and ventrals whitish. Under surface of head with livid grayish tints. Iris slaty. Length 21 inches. Atlantic City.



Eel Pout. *Zoarces anguillaris* (Peck).

Two fine examples from the above locality, one presented to the Academy of Natural Sciences of Philadelphia by Dr. H. D. Senior. It is usually recorded from our shore in cold weather.

*Zoarces anguillaris* Abbott, Geol. N. J., 1868, p. 818.

*Zoarces ciliatus* Abbott, l. c.

### Family OPHIDIIDÆ.

#### The Cusk Eels.

Body elongate, compressed, more or less eel-shaped. Head large. Both jaws and usually vomer and palatines also with villiform or cardiform teeth. Lower jaw included. Premaxillaries protractile. Gill-opening very wide, membranes separate, anteriorly narrowly joined to isthmus behind ventrals. Gills 4,

a slit behind fourth. Pseudobranchiæ small. Air-vessel present. Pyloric cæca present. Body usually covered with very small scales which are not imbricated but placed in oblique series at right angles with each other. Vertical fins low, without spines, confluent around tail. Tail isocercal. Ventrals at throat, each developed as a long forked barbel.

Carnivorous fishes of most warm seas, some descending to considerable depths.

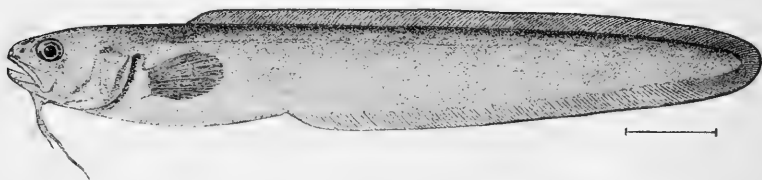
Genus *RISSOLA* Jordan and Evermann.

The Sand Cusks.

*Rissola marginata* (De Kay).

Sand Eel.

Head  $5\frac{1}{3}$ ; depth  $8\frac{7}{8}$ ; D. 154; A. 125; caudal 8; snout  $4\frac{2}{3}$  in head; eye  $4\frac{1}{3}$ ; maxillary  $2\frac{1}{3}$ ; interorbital space  $6\frac{1}{3}$ ; pectoral



Sand Eel. *Rissola marginata* (De Kay).

$1\frac{1}{3}$ ; ventral  $1\frac{1}{4}$ . Body elongate, strongly compressed, and tail not especially tapering from vent. Head obtuse, compressed. Snout obtuse, bluntly conic, and protruding beyond mandible. Eye anterior, a little longer than deep. Mouth rather large, little inclined, and maxillary reaching a trifle beyond posterior margin of pupil, but not that of orbit. Lips fleshy, a little thick. Teeth small, pointed, in bands in jaws and those anteriorly a little enlarged. Broad patches of vomerine and palatine teeth a little more obtuse. Tongue small, free and pointed. Interorbital space narrow and a trifle convex. Gill-rakers  $11 + 4$ , lanceolate, strong, and longest about  $\frac{3}{4}$  of horizontal diameter of pupil. Scales elongate, or lozenge-shaped, numerous and irregularly adherent.

Lateral line high and concurrent with dorsal profile. Dorsal begins about over middle of pectoral and confluent around short rounded caudal with anal which begins about first  $\frac{3}{8}$  of length of head and trunk. Pectoral broad, a little less than  $\frac{2}{3}$  to anal. Ventral long, inserted just before posterior margin of orbit, reaching half way to anal, and inner ray half length of outer. Color in life plain pale brownish generally. Dorsal, anal and caudal margined with blackish-brown. Length  $5\frac{3}{4}$  inches. Cape May.

My examples from the above locality, Atlantic City and Beesley's Point, also one from Avalon which was picked up on the beach October 17th, 1897, by Mr. David McCadden. It is probably more abundant than generally supposed and on account of its seclusive habits, such as burying in the sand, may readily escape observation.

*Ophidium marginatum* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 351.—Abbott, Geol. N. J., 1868, p. 819.—Verrill, Am. Nat., V, 1871, p. 399.—Bean, Bull. U. S. F. Com., VII, 1887, p. 135, from Baird.

*Ophidion marginatum* Moore, Bull. U. S. F. Com., XII, 1892, p. 363.

### Family AMMODYTIDÆ.

#### The Sand Launces.

Body elongate, compressed. Head long. Eye moderate. Mouth rather large, nearly horizontal, lower jaw considerably projecting, its symphysis produced. No teeth in jaws. Pre-maxillaries very protractile. Maxillaries long and slender. Opercles well developed, without spines or serratures. Gill-openings very wide. Gill-membranes not united, free from isthmus. Gill-rakers long and slender. Gills 4, a slit behind fourth. Pseudo-branchiæ large, lamellate. Branchiostegals 6 to 8. Lower pharyngeals very small, separate. Pyloric cœca usually 1. No air-vessel. Body covered with small cycloid scales. Lateral line running along side of back. Spinous dorsal absent. Rayed dorsal very long and low, fragile, extending from behind head to near base of caudal. Anal similar to dorsal, but smaller. Caudal

small, forked. Pectorals inserted low. No ventral fins. Vent inserted behind middle of body.

Small carnivorous fishes swimming in large schools near the shore and burying themselves in the sand along the coasts of northern regions.

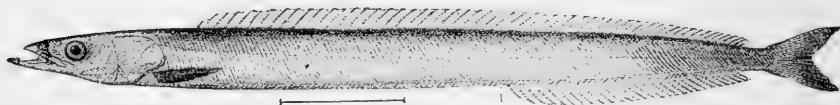
### Genus AMMODYTES Linnæus.

#### The Sand Launces.

#### *Ammodytes americanus* De Kay.

#### Sand Lance.

Head  $5\frac{1}{6}$ ; depth  $12\frac{3}{4}$ ; D. 60; A. 1, 30; scales about 145 in a lateral series to base of caudal; 3 scales between base of dorsal and lateral line; about 12 scales in a vertical series between origin of anal and lateral line; mandible  $2\frac{1}{2}$  in head; caudal  $2\frac{2}{7}$ ;



Sand Lance. *Ammodytes americanus* De Kay.

pectoral  $2\frac{1}{4}$ ; least depth of caudal peduncle  $6\frac{1}{4}$ ; snout  $3\frac{1}{2}$  in head, measured from tip of upper jaw; eye 7; maxillary  $3\frac{1}{2}$ ; interorbital space  $7\frac{2}{3}$ . Body elongate, lanceolate and rather cylindrical. Head attenuate, compressed. Snout conic, long. Eye a little elongate, its center in first  $\frac{2}{3}$  of head. Mouth a little inclined, long, and mandible well produced. Rami of mandible well elevated inside mouth. Maxillary slender, reaching orbit. Interorbital space flattened. Gill-rakers  $5 + 24$ , very slender, long, longest nearly equal to horizontal orbital diameter. Skin with many transverse folds obliquely downward and backward and small cycloid scales in cross series between. Lateral line concurrent and close to dorsal profile. A low dermal fold along each side of belly. Dorsal inserted a trifle before tip of pectoral. Anal inserted a little nearer tip of caudal than origin of pectoral. Caudal emarginate. Pectoral small. Mostly silvery, olive above. Length  $8\frac{1}{8}$  inches. Cape May.

Frequently found along our shores at Cape May, Beesley's Point and Ocean City. They bury in the sand near the tide marks and sometimes are washed upon the shores.

*Ammodytes americanus* Abbott, Geol. N. J., 1868, p. 816.

### Sub-Order HAPLODOCI.

#### The Toad Fishes.

It contains a single family, the *Batrachoididæ*.

### Family BATRACHOIDIDÆ.

#### The Toad Fishes.

Body more or less robust, depressed anteriorly, compressed behind. Head large, depressed, its muciferous channels well developed. Mouth very large. Teeth generally strong. Premaxillaries protractile. Suborbital without bony stay. Post-temporal bone simple, undivided. Gill-openings restricted to sides, membranes broadly united to isthmus. Gill-rakers present, moderate. Gills 3, a slit behind last. Pseudobranchiæ none. Branchiostegals mostly 6. Pyloric cœca none. Vertebrae in large number, 32 to 45. Dorsal fins 2, first of II or III low stout spines. Rayed dorsal very long. Anal fin similar, but shorter. Tail diphycercal, caudal fin distinct, rounded. Pectorals very broad, rays branched. Ventrals rather large, jugular, I, 2 or I, 3.

Carnivorous fishes of the coasts, mostly in warm seas, some ascending rivers. The young of all the species fasten themselves to rocks by means of an adhesive disk which soon disappears. One species on our coast.

### Genus OPSANUS Rafinesque.

#### The Toad Fishes.

*Opsanus tau* (Linnæus).

#### Toad Fish. Oyster Fish.

Head  $2\frac{5}{6}$ ; depth  $4\frac{1}{2}$ ; D. III, 26; A. 21; width head  $1\frac{1}{10}$  in its length; width of mouth  $1\frac{3}{7}$ ; interorbital space  $3\frac{1}{2}$  in head,

measured from tip of upper jaw; eye  $7\frac{1}{2}$ ; sixth dorsal ray 3; sixth anal ray 5; least depth of caudal peduncle  $4\frac{1}{2}$ ; caudal  $2\frac{1}{2}$ ; pectoral  $1\frac{3}{4}$ ; ventral  $2\frac{1}{2}$ . Body comparatively short, robust. Head large, depressed, broad. Eye a little elongate, superior. Mouth large, mandible protruding. Jaws, vomer and palatines with a single series of strong blunt teeth, and mandible with an additional series at symphysis. Teeth of upper jaw small, those of mandible small anteriorly and regularly increasing in size backward. Vomerine teeth prominent. Dentary bones forming an acute angle at symphysis. Lips fleshy. Tip of maxillary and lower side of mandible with conspicuous cirri. A series of smaller cirri along margin of preopercle. Subopercle ending in a long sharp spine. Upper angle of opercle with 2 diverging spines more or less concealed in skin. Interorbital space fleshy and depressed. Gill-rakers as 11 fleshy tubercles on first arch. Body naked. Lateral line obscure, pores inconspicuous. Pores on head and a large one in axil of pectoral. Dorsal spines short, covered with skin, and first inserted at end of head. Rayed dorsal covered with skin, tips of radii free, and inserted a little nearer tip of mandible than base of caudal. Anal similar, lower, and a little posterior in insertion. Caudal short, rounded. Pectoral broadly expanded, nearly to vent. Ventral thick and fleshy, space between but little less than length of fin. Dusky-olive variegated with darker or blackish. Length 10 inches. Beesley's Point.

Many examples from the above locality, some of which are newly-hatched young, Sea Isle City, Atlantic City and Cape May. In all these places it is abundant. Not valued as food. This voracious fish reaches a length of 15 inches, and with its powerful jaws crunches up crabs and oysters in its life along the bottom.

*Batrachus tau* Abbott, Geol. N. J., 1868, p. 817.

*Batrachus tau* Verrill, Am. Nat., V, 1871, p. 398.—Bean, Bull. U. S. F. Com., VII, 1887, p. 135.—Moore, Bull. U. S. F. Com., XII, 1892, p. 363.

*Batrachoides variegatus* Le Sueur, Journ. Acad. Nat. Sci., Phila., III, 1823, pp. 399, 401.

*Batrachus variegatus* Baird, 9th An. Rep. Smiths. Inst., 1854, p. 340.



**Order ANACANTHINI.****The Spineless Jugular Fishes.**

A large group in the cold waters of northern seas, separated from other typical fishes by the entire hypercoracoid.

*Key to the families.*

- a.* Chin with barbel, rarely obsolete; frontal ones without a triangular excavated area above. GADIDÆ  
*aa.* No barbels; frontal bones paired, with triangular excavated area above, divergent frontal crests continuous from forked occipital crest.

MERLUCCIIDÆ**Family GADIDÆ.****The Cod Fishes.**

Body more or less elongate, caudal region moderate, coniform behind and with caudal rays procurent above and below. Mouth large, terminal. Chin with a barbel more or less developed. Edge of preopercle usually covered by skin of head. Suborbital bones moderate. Gill-openings very wide. Gill-membranes separated or somewhat united, commonly free from isthmus. Gills 4, a slit behind fourth. No pseudobranchiæ. Air-vessel generally well developed. Pyloric cæca usually numerous, but sometimes few or none. Scales small, cycloid. No spines, fin rays all articulated. Dorsal fin extending almost length of back, forming 1, 2 or 3 fins. Anal long, single or divided. Caudal distinct, or confluent with dorsal and anal. Ventrals jugular, attached to pubic bone, each of 1 to 8 branched rays.

Fishes chiefly of northern seas, some living in the oceanic abysses. Many are important food-fishes.

*Key to the genera.*

- a.* GADINÆ. Anal divided as 2 separate fins, dorsal as 3.  
*b.* Lower jaw protruding beyond upper; barbel small or obsolete; caudal concave behind. POLLACHIUS

# 414 REPORT OF NEW JERSEY STATE MUSEUM.

- bb. Lower jaw not protruding beyond upper; barbel well developed; caudal not concave behind.
- c. Lateral line pale.
- d. Vent in front of second dorsal; size small. MICROGADUS
- dd. Vent below second dorsal; size large. GADUS
- cc. Lateral line black. MELANOGRAMMUS
- aa. Anal forming a continuous fin or sometimes deeply notched; dorsal not divided as 3 fins.
- e. Dorsal divided into 2 fins.
- f. LOTINÆ. Ventrals broad, each of about 6 rays; vomer with teeth. LOTA
- ff. PHYCINÆ. Ventrals very slender, each of 2 or 3 rays. PHYCIS
- ee. BROSMINÆ. Dorsal continuous, undivided; mouth large. BROSMIE

## Genus POLLACHIUS Bonaparte.

### The Pollocks.

#### Pollachius virens (Linnæus).

#### Pollock.

Head  $3\frac{3}{4}$ ; depth  $4\frac{3}{7}$ ; D. 14-20-IV, 15, 1; A. v, 18-VI, 16; P. II, 20; V. I, 5; snout  $2\frac{4}{5}$  in head, measured from tip of upper jaw; eye  $10\frac{1}{2}$ ; maxillary  $2\frac{7}{8}$ ; interorbital space  $3\frac{1}{2}$ ; mandible  $2\frac{1}{4}$  in head, measured from its own tip; pectoral  $2\frac{1}{3}$ ; ventral  $4\frac{1}{4}$ ; first branched dorsal ray of first dorsal  $3\frac{1}{10}$ ; same of second dorsal  $3\frac{1}{10}$ ; same of third dorsal 5; same of first anal  $3\frac{3}{5}$ ; same of second anal 5; least depth of caudal peduncle  $4\frac{3}{5}$ ; lower caudal lobe 2. Body rather long, well compressed, deepest anteriorly. Head rather large and compressed. Snout conic. Eye small. Mouth oblique and rather small, mandible protruding in front. Teeth in jaws more or less uniform. Color of skin leaden-gray, turning to dusky olive-black above and on back and inclining more to whitish on lower surface. Lateral line pale. Dorsals and caudal dusky. Anals pale like belly, marginally darker. Pectoral brownish. Ventral whitish. Iris leaden. Length 39 inches. Probably off Long Branch early in 1903.

A large fish of the north Atlantic, chiefly north of our shores. Known to me only from the above example, now in the State

Museum at Trenton, which I have had the opportunity of examining through Prof. Silas R. Morse. The latter states that it was obtained somewhere off the north shores, possibly near Long Branch.

*Pollachius virens* Smith, Bull. U. S. Fish Com., XII, 1892, p. 379.

*Merlangus purpureus* Abbott, Geol. N. J., 1868, p. 819.

### Genus MICROGADUS Gill.

#### The Tom Cods.

#### **Microgadus tomcod** (Walbaum).

#### PLATE 93.

#### Tom Cod. Frost Fish.

Head 4; depth 4; D. 12-18-19; A. 23-18; scales about 110 along lateral line superiorly to base of caudal, and about a dozen more on latter; 17 scales between origin of first dorsal and lateral line; 26 scales in a vertical series between origin of anal and lateral line; snout  $2\frac{7}{8}$  in head; eye  $6\frac{2}{5}$ ; maxillary  $2\frac{1}{4}$ ; inter-orbital space  $3\frac{1}{3}$ ; base of first dorsal 2; fourth ray of second dorsal  $2\frac{1}{4}$ ; seventh ray of third dorsal  $2\frac{1}{5}$ ; seventh ray to first anal  $2\frac{1}{4}$ ; seventh ray to second anal  $2\frac{1}{2}$ ; least depth of caudal peduncle 4; caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{3}{5}$ ; ventral  $1\frac{2}{5}$ . Body elongately ovoid, rather deep, compressed. Head a little long, convex above, somewhat compressed with vertical sides. Snout obtusely convex and protruding beyond mandible. Eye small, circular, and a little anterior. Mouth rather large, lips fleshy. Bands of small pointed teeth in jaws, outer series a little enlarged. A patch of smaller vomerine teeth. Maxillary reaching nearly to middle of orbit. Barbel small, a little less than orbit. Interorbital space a little convex. Gill-rakers 15, short and fleshy,  $\frac{2}{3}$  of pupil. Scales small, especially reduced or crowded before dorsal, on head and belly. First dorsal a little nearer tip of snout than origin of third fin. Second dorsal inserted a little nearer base of caudal than tip of snout, and its base but little less than head. Third

dorsal inserted nearer base of caudal than origin of second. Caudal rounded. First anal a little in advance of origin of second dorsal and elevated anteriorly. Second anal inserted opposite and similar to third dorsal. Pectoral short, about reaching anal. Ventral inserted a little nearer anal than tip of snout, though falling a little short of former when depressed. Color olive-brown, and beautifully blotched and spotted with darker, same on dorsals and caudal. Anals punctulate anteriorly, colorless posteriorly. Pectorals and ventrals dusky. Length  $11\frac{1}{4}$  inches. Beesley's Point.

Known to me mostly from Sea Isle City where it is said to be abundant most all winter. Valued as a food-fish. It is also abundant in winter off Asbury Park.

*Microgadus tomcodus* Abbott, Geol. N. J., 1868, p. 818.

## Genus GADUS Linnæus.

### The Cod Fishes.

#### *Gadus callarias* Linnæus.

PLATE 94.

### Cod. Cod Fish.

A large fish distinguished from the preceding by the position of the vent which is below the second dorsal.

Although I have no examples of this well-known food-fish from our shores, I have found it very abundant at various points along our coast, mostly at Cape May, Stone Harbor, Sea Isle City and Atlantic City. They appear early in November accompanied by the dog sharks (*Squalus acanthias*), or cod sharks as they are called by the fishermen. It is abundant off Asbury Park, Ocean Grove and Long Branch.

*Gadus monhua* Abbott, Geol. N. J., 1868, p. 818, evidently lapsus for *morrhua*.

*Morrhua americana* Abbott, Am. Nat., IV, 1870, p. 116.

*Gadus morrhua* Smith, Bull. U. S. F. Com., XII, 1892, p. 379.

## Genus MELANOGRAMMUS Gill.

## The Haddocks.

*Melanogrammus æglefinus* (Linnæus).

PLATE 95.

## Haddock.

A large fish easily distinguished from any other in the family by the black lateral line.

I have no examples. It is not very abundant, however, off our north shores. I have records of examples from Asbury Park and Long Branch, where occasionally a few are seen. It is considered a good food-fish.

*Melanogrammus æglefinus* Abbott, Geol. N. J., 1868, p. 818.—Smith, Bull. U. S. F. Com., XII, 1893, p. 379.

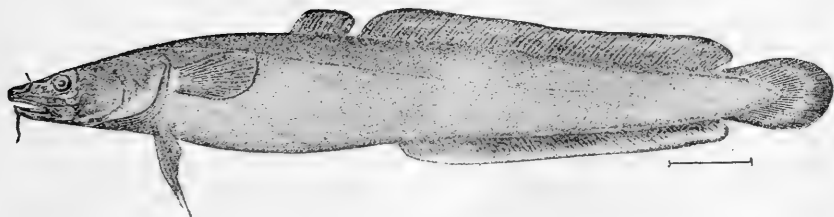
*Melanogrammus æglepinus* Goode, Am. Nat., IX, 1875, p. 517, on an albino.

## Genus LOTA Oken.

## The Burbots.

*Lota maculosa* (Le Sueur).

Mud Blower. Ling.

Mud Blower. *Lota maculosa* (Le Sueur).

This is the only fresh-water representative of the family. It is distinguished from the hakes principally by the rather broad ventrals, each of 6 rays, and from the cusk by 2 dorsal fins.

I have never seen any New Jersey examples. It has been recorded as occurring in the Delaware River at the head of Burlington Island, in 1883, by Dr. Charles C. Abbott. At that time the island was said to form a gradual sloping shore, flat at its upper end. It was discovered by means of bubbles which were seen to emanate from certain depressions or holes in which the fish was found buried. Dr. Charles C. Abbott tells me that the fish was identified by Dr. J. De B. Abbott. During the summer of 1903 I visited this locality without success, and since that time the flat has been reported to have been washed away.

*Lota maculosa* Abbott, Nat. Rambles, 1885, p. 478.

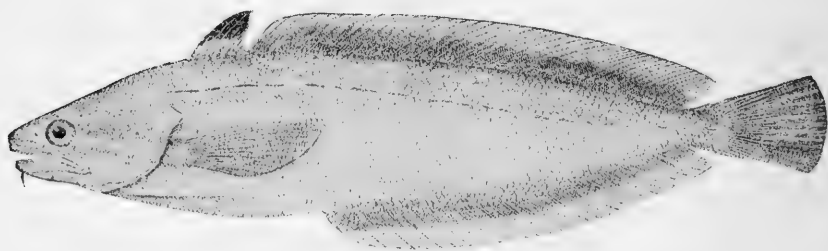
### Genus PHYCIS Walbaum.

#### The Hakes.

#### *Key to the species.*

- |   |        |
|---|--------|
| a. First dorsal not elevated, none of its rays filamentous; scales about 80 to base of caudal.        | REGIUS |
| aa. First dorsal elevated, 1 or more rays filamentous; scales smaller, 100 or more to base of caudal. |        |
| b. Scales about 138.  | TENUIS |
| bb. Scales about 95 to 110.   | CHUSS  |

#### *Phycis regius* (Walbaum).



Hake. *Phycis regius* (Walbaum).

Head  $3\frac{4}{5}$ ; depth  $4\frac{1}{8}$ ; D. VIII-47; A. 45; scales about 80 in a lateral series below lateral line to base of caudal, and about 7 more on latter; 6 scales obliquely back from origin of spinous dorsal to lateral line; 19 scales in a vertical series between origin

of anal and lateral line; snout 4 in head; eye  $5\frac{1}{2}$ ; maxillary 2; interorbital space  $3\frac{4}{7}$ ; seventh dorsal spine  $3\frac{1}{2}$ ; seventeenth dorsal ray about 2; twentieth anal ray  $2\frac{1}{8}$ ; caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{5}$ ; least depth of caudal peduncle  $4\frac{3}{5}$ . Body rather elongate and compressed. Head a little large, depressed above, and compressed a little laterally. Snout broad, convexly depressed, and protruding a little beyond mandible. Eye circular, about first third in head. Mouth large, and maxillary reaching a trifle beyond posterior margin of orbit. Lips a little fleshy. Teeth in jaws and on vomer cardiform. Interorbital space rather broad, flattened or only slightly convex. Gill-rakers  $3 + 14$ , slender, and longest about  $\frac{4}{5}$  of orbit. Scales large, reduced and crowded on head and predorsal region. Lateral line high, concurrent with dorsal profile, and of simple tubes. Spinous dorsal inserted a little behind origin of pectoral. Origin of rayed dorsal falling about opposite middle of pectoral. Anal inserted a little nearer tip of snout than base of last dorsal ray. Caudal long, truncate, with rounded edges. Pectoral reaching anal. Ventral inserted about midway between anterior margin of orbit and origin of pectoral, reaching anal, and inner ray about  $\frac{5}{7}$  length of outer. Color pale brownish, becoming paler below. Lateral line dark brown, interrupted by whitish spots less than size of pupil. Vertical fins all dull brownish like back, becoming gradually more dusky marginally. Spinous dorsal largely black on outer portion, margined narrowly with whitish. Pores on side of head with dusky. Pectoral dusky-brown. Ventral whitish. Length  $10\frac{1}{4}$  inches. Atlantic City.

This example procured by Prof. Cope is the only one I have seen. The species is said to exhibit electric power in life, and ranges from shallow water to a depth of 167 fathoms.

**Phycis tenuis (Mitchill).**

Hake. Ling. Thimble Eyed Ling.

Distinguished from our other species by its small scales.

I have no example. It is not, however, very abundant and is usually taken in winter.

*Phycis tenuis* Abbott, Geol. N. J., 1868, p. 819.—Smith, Bull. U. S. F. Com., XIII, 1892, p. 379.

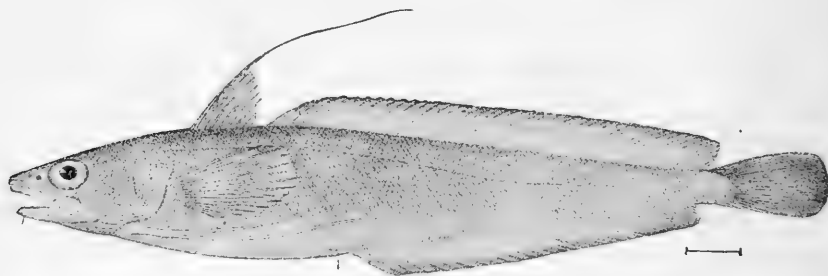


Ling. *Phycis tenuis* (Mitchill).

***Phycis chuss* (Walbaum).**

Ling. Thimble Eyed Ling.

Head  $4\frac{2}{3}$ ; depth  $5\frac{2}{5}$ ; D. IX-57; A. 51; P. 14; V. 2; scales about 94 (squamation injured) from gill-opening above to base of caudal; about 20 scales obliquely up and back from origin of anal to lateral line; about 6 scales between middle of base of spinous dorsal and lateral line; about 7 scales in a trans-



Thimble Eyed Ling. *Phycis chuss* (Walbaum).

verse series on caudal peduncle; width of head  $1\frac{5}{6}$  in its length; depth of head over posterior margin of eye  $2\frac{1}{3}$ ; snout  $3\frac{3}{5}$ ; eye  $5\frac{1}{4}$ ; maxillary  $2\frac{1}{5}$ ; mandible  $2\frac{1}{4}$ ; interorbital space  $4\frac{4}{5}$ ; pectoral  $1\frac{3}{7}$ ; caudal  $1\frac{2}{3}$ ; least depth of caudal peduncle  $4\frac{5}{6}$ ; width of mouth at maxillaries posteriorly  $2\frac{2}{3}$ . Body rather slender, well compressed. Head depressed. Snout broad, depressed, and tip bluntly rounded. Eye large, a little elongate and well



anterior. Mouth oblique, and snout projecting beyond mandible. Lips fleshy. Maxillary reaching a little past middle of pupil, but not to its posterior margin. Teeth small, sharp, in bands in jaws. A patch of finer vomerine teeth. Interorbital space level. Gill-rakers  $4 + 13$ , compressed, lanceolate, and longest about equals diameter of pupil. Scales rather large, reduced and crowded on head. Lateral line high along back. Spinous dorsal inserted about over first  $\frac{2}{3}$  of pectoral, and base of fin a trifle greater than orbit horizontally. Second dorsal begins about opposite last sixth of pectoral. Anal inserted nearer tip of snout than base of last anal ray. Caudal rounded. Pectoral reaching  $\frac{2}{3}$  of space to anal. Ventral inserted nearly midway between tip of snout and origin of spinous dorsal, reaching anal, and inner ray  $\frac{3}{5}$  length of outer. General color fawn-brown, having a minutely or rather dusted appearance. Abdominal region or lower surface of body dull white and there dots a little more pronounced. Fins all more or less of same color, dorsal and caudal, and anal posteriorly, becoming a little darker distally and margin narrowly dusky. Anal pale, or like abdomen, basally and more or less sprinkled with fine brownish dots. Along side of head from above maxillary a diffuse brownish streak toward base of pectoral. Under surface of head and jaws white. Spinous dorsal uniform brown like rayed fin. Pectoral brownish, upper rays deeper. Ventral whitish, sprinkled with brownish. Iris brassy-silvery with brownish reflections. Length  $18\frac{1}{2}$  inches. Sea Isle City.

Only the above example, received from Dr. H. D. Senior. It is said to occur at a depth of 300 fathoms.

*Phycis chuss* Smith, Bull. U. S. F. Com., XII, 1892, p. 379.

### Genus *BROSME* Oken.

#### The Cusks.

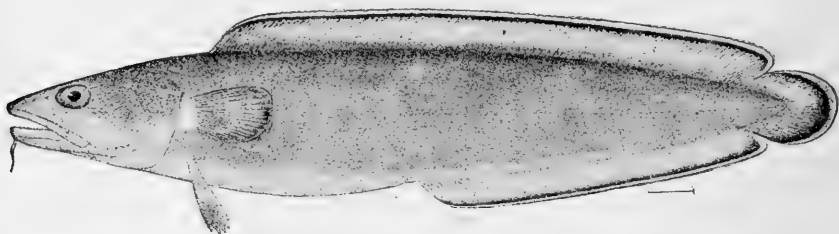
***Brosme brosme* (Müller).**

#### Cusk.

Distinguished by the continuous anal and dorsal with rounded caudal, and rather large teeth.

I have never seen any New Jersey examples. It is only known from Dr. Abbott's record of 2 examples from Cape May.

*Brosmius brosme* Abbott, Geol. N. J., 1868, p. 819.



Cusk: *Brosme brosme* (Müller).

### Family MERLUCCIIDÆ.

#### The Hakes.

Body moderately elongate. Head elongate, depressed, pike-like. Suborbital bones moderate. Mouth terminal, with strong teeth. No barbels. Ribs wide, approximated and channeled below or with inflected sides. Frontal bones paried, excavated, with divergent crests continuous from forked occipital crest. Body covered with small smooth deciduous scales. Posterior part of body coniform and with caudal rays procurent forward. Vent submedian. Dorsal fins 2, a short anterior and long posterior one. A long anal corresponding to second dorsal. Ventrals subjugular.

Large cod-like fishes of voracious habit, inhabiting moderate depths.

#### Genus MERLUCCIUS Rafinesque.

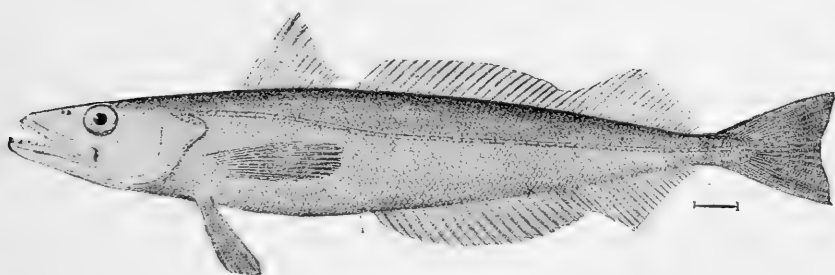
#### The Hakes.

#### *Merluccius bilinearis* (Mitchill).

#### Hake.

Head  $3\frac{1}{2}$ ; depth  $6\frac{3}{5}$ ; D. 11 - 21 - 19; A. 20 - 19; scales 104 just above lateral line to base of caudal, and 8 more on latter;

8 scales between origin of first dorsal and lateral line; 17 scales obliquely back from origin of anal to lateral line; mandible  $1\frac{2}{3}$  in head; second dorsal ray of first fin  $2\frac{1}{6}$ ; third ray of second dorsal 4; sixth ray of third dorsal  $2\frac{3}{4}$ ; twelfth ray of first anal 4; upper caudal lobe  $1\frac{2}{3}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{3}{4}$ ; snout 3 in head measured from tip of upper jaw; eye 5; maxillary  $1\frac{7}{8}$ ; interorbital space  $3\frac{3}{4}$ ; least depth of caudal peduncle  $6\frac{1}{4}$ . Body elongate, compressed, and tapering well from vent backwards. Head slender, conic, but little compressed. Snout depressed. Eye circular, anterior and high. Mouth large, oblique, and mandible well protruding in front. Teeth large, conspicuous, those in upper jaw especially enlarged. Maxillary not quite reaching opposite posterior orbital margin. Top of head with W-shaped ridges conspicuous. Interorbital space flat. Gill-



Hake. *Merluccius bilinearis* (Mitchill).

rakers 15 + 13 1, compressed, elongate, and longest 2 in orbit. Scales large, reduced on top of head and predorsal region. Lateral line concurrent with back above. First dorsal inserted about over first fourth of depressed pectoral, and its base  $2\frac{2}{5}$  in that of second dorsal, which is inserted a trifle before tip of pectoral. Third dorsal inserted nearer base of caudal than origin of anal, its base  $1\frac{4}{5}$  in that of second dorsal. Origin of first anal a little nearer tip of mandible than base of caudal. Second anal inserted a trifle before third dorsal. Caudal with posterior margin convex. Pectoral nearly reaching origin of anal. Ventral inserted as far in advance of origin of pectoral as first dorsal is posterior and reaching about three-fifths of space to anal. Color gray-brown, darker on middle of back. Lower surface dull silvery. Lips

dusky. Upper fins, caudal and pectoral tinted dusky. Inside of gill-opening soiled with dusky. Length  $19\frac{3}{4}$  inches. Sea Isle City.

Two examples have been examined from the above locality. Breeding in deep water, and though considered as a food-fish it is little valued.

*Merlucius vulgaris* Abbott, Geol. N. J., 1868, p. 819.

## Order PEDICULATI.

### The Pediculate Fishes.

This is an offshoot from the *Acanthopteri*, perhaps nearest related to the *Batrachoididæ*.

### Key to the families.

*a.* Pseudobranchiæ present.

LOPHIIDÆ

*aa.* No pseudobranchiæ.

ANTENNARIIDÆ

## Family LOPHIIDÆ.

### The Anglers.

Body contracted, conical, tapering rapidly backward from shoulders. Head wide, depressed, very large. Mouth exceedingly large, terminal, opening into an enormous stomach. Upper jaw protractile. Maxillary without supplementary bone. Lower jaw projecting. Both jaws with very strong unequal cardiform teeth, some canine-like, most depressible. Vomer and palatines usually with strong teeth. Gill-openings comparatively large, in lower axil of pectorals. Gills 3. Gill-rakers none. Pseudobranchiæ present. Pyloric cæca present. Skin mostly smooth, naked, with many dermal flaps about head. Spinous dorsal of III isolated tentacle-like spines on head, and III smaller ones behind forming a continuous fin. Second dorsal moderate, similar to anal. Pectoral members scarcely geniculated, each with 2 actinosts and with elongate pseudobranchia. Ventrals jugular, I,

5, widely separated, large, much enlarged in young. Young with head spinous.

Large fishes of sea-bottoms at moderate or great depth and remarkable for their great voracity. A single species on our shores.

Genus *LOPHIUS* Linnæus.

The Anglers.

*Lophius piscatorius* Linnæus.

PLATE 96.

Bellows Fish. All Mouth. Angler. Satchel Mouth. Head Fish.  
Goose Fish.

Width of head 2; D. I—I—I—III, 11; A. 9; P. about 26; intermaxillary width about  $1\frac{1}{3}$  in greatest width of body; interorbital space  $4\frac{1}{4}$ ; first dorsal spine about  $2\frac{1}{8}$ ; length of caudal about  $3\frac{1}{2}$ ; greatest width of pectoral about 2; eye 5 in interorbital space; least depth of caudal peduncle  $2\frac{2}{3}$ . Caudal peduncle depressed. Eye elongate or ellipsoid. In jaws 4 series of backwardly directed sharp conic teeth, rather large, each pair approximated anteriorly, and each series of about equal distance posteriorly. Two patches of upper pharyngeal teeth. Humeral spine with 2 points, posterior larger and stronger. Head with a fringe of barbels along margin. Interorbital space broadly concave. On each side of mouth in front are 2 spines. Anterior dorsal spine with fleshy tip, and when depressed reaching well beyond base of third. Fourth dorsal spine longer than fifth. Rayed dorsal begins about last third in length of head and trunk. Anal begins behind dorsal. Fringe of filaments each side of body. Ventral very fleshy plicate, falling about first fifth in head and trunk, and interventral space a little greater than interorbital. Color chocolate-brown above, mottled finely with darker. Lower surface, including under surface of pectoral which has dark margin, soiled whitish. Anal tinted with brownish. Caudal

colored like back. Ventrals dirty white. Length about 41 inches. Delaware Bay.

This large fish is abundant on our coast and is known by a variety of common names. It is noted for its great voracity and exceptional ugliness of appearance. I have records of its capture at Cape May, Stone Harbor, Sea Isle City, Atlantic City and Asbury Park. It also occurs in deep water, but is usually seen in our limits about the shallows, where it is frequently taken by fishermen. It is not used as food and is usually the object of disgust.

*Lophius americanus* Valenciennes, Hist. Nat. Poiss., XII, 1837, p. 283.

*Sophius americanus* Abbott, Geol. N. J., 1868, p. 818, evidently misprint for *Lophius*.

### Family ANTENNARIIDÆ.

#### The Frog Fishes.

Head and body more or less compressed. Mouth very oblique, opening upward. Lower jaw projecting. Premaxillary protractile. Jaws with cardiform teeth. Gill-openings small, pore-like, in or behind lower axils of pectorals. Gills  $2\frac{1}{2}$  or 3. No pseudo-branchiæ. No pyloric cæca. Skin naked, smooth or prickly. Pectoral members forming an elbow-like angle. Pseudobranchia long, with 3 actinosts. Spinous dorsal of I to III serrated tentacle-like spines. Rayed dorsal long, larger than anal. Ventrals present, jugular, near together.

Fishes of tropical seas, pelagic, often living in or among floating sea-weed. By filling their capacious stomachs with air they are enabled to sustain themselves on the surface of the water. Two species straying to our shores.

#### Genus PTEROPHRYNE Gill.

#### The Mouse Fishes.

#### Key to the species.

- a. Bait on first dorsal bifurcate at tip.
- aa. Bait on first dorsal bulbous, covered with fleshy filaments.

HISTRIO  
GIBBA

**Pterophryne histrio** (Linnæus).

## Mouse Fish.

Distinguished from the next chiefly by the bifurcate bait on first dorsal.

This is a Gulf Stream straggler in floating seaweed, especially floating masses of *Sargassum*. It is very variable in color. Once recorded by Dr. Abbott from Beesley's Point. I have no examples.

*Antennarius variegatus* Abbott, Geol. N. J., 1868, p. 818.

**Pterophryne gibba** (Mitchill).

Bait bulbous and covered with fleshy filaments.

Dr. Abbott states this species is more frequently met with than the preceding. I have never seen any New Jersey examples.

*Antennarius gibbus* Abbott, Geol. N. J., 1868, p. 818.





## APPENDIX.

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### INTRODUCED SPECIES.

In this appendix the known introduced species of fishes within the limits of the state are given. The prime object in the introduction of most of them was, of course, their utility as either food or game animals. In preparing this account I was so fortunate as to procure some interesting information from Mr. James M. Stratton, of the Fish and Game Commission. Mr. Stratton kindly criticised my list, informing me that the enumeration of the introduced species is correct. He also states that the Commission makes no attempt to introduce any species but large and small mouthed black bass, pike, perch, white or silver bass, strawberry bass and crappie. The tench, ide, common or round white fish, lake herring or cisco, tullibee, lake tahoe trout, steel head trout, lockleven trout, rainbow trout, swiss lake trout, lake trout, sunapee trout, warmouth and green sun fish have never been introduced by the Fish and Game Commission. If any do occur they have been brought here by private individuals and placed in private waters.

### Family CYPRINIDÆ.

#### The Carps.

The species introduced into our waters all belong to the *Cyprininae*, or those with an elongate dorsal fin, and both dorsal and anal preceded by a serrated spine. The teeth on the pharyngeals are molar.

#### *Key to the genera.*

a. Barbels 4; teeth 1, 1, 3-3, 1, 1.

aa. Barbels none; teeth 4-4.

CYPRINUS

CARASSIUS

Genus *CYPRINUS* Linnæus.

The Carps.

*Cyprinus carpio* Linnæus.

PLATE 97.

Carp. Mirror Carp. Leather Carp.

A fish of large size distinguished from the gold fish chiefly by the presence of 4 barbels.

It was originally introduced from the fresh waters of Central Asia, and to America as a food-fish usually in ponds. In domestication it has produced many varieties, principal among these are those with very large scales (mirror carp) and those which are scaleless (leather carp). It is usually considered a very poor food-fish, though perfectly at home in foul water and often found in muddy streams. Though living even in salt water and stagnant pools, its flesh is then inferior. When wounded they bleed profusely. The leather carp is said to be best for transportation. Though said to attain 90 pounds in weight, those in our limits seldom weigh more than a third of this. They feed largely on vegetable matter and take the hook readily with most bait. Spawning takes place in the spring.

*Cyprinus carpio* E. Smith, Proc. Linn. Soc. N. Y., IX, 1897, p. 28.

Genus *CARASSIUS* Nilsson.

The Crucian Carps.

*Carassius auratus* (Linnæus).

PLATE 98.

Gold Fish.

This fish is, perhaps, too well known to need description. Originally a native of China and Japan it has been introduced into America and is now in many of our streams a permanent

feature. The wild fish is largely olive in color, but through domestication various shades of color are induced, such as orange, silvery or black, together with abnormally shaped fins and eyes. It is the favorite aquarium fish and is also introduced into most ponds, reservoirs, fountains and lakes. It is said to breed in foul water during early spring. It reaches a length of a foot and is not used as food.

### Family SILURIDÆ.

#### The Cat Fishes.

Represented by a single introduced species.

#### Genus ICTALURUS Rafinesque.

##### The Channel Cats.

*Ictalurus punctatus* (Rafinesque).

##### Spotted Cat Fish.

Distinguished from any of our other fresh water cat fishes by the complete bony bridge from the head to the dorsal spine.

Introduced from the Great Lakes and Mississippi valley region. It is generally abundant in the channels of the larger streams. An excellent food-fish reaching a weight of 25 pounds. It is very variable.

*Ichthælorus punctatus* Abbott, Nat. Rambles, 1885, p. 479.

#### Genus AMEIURUS Rafinesque.

##### The Horned Pout.

*Ameiurus lacustris* (Walbaum).

##### Lake Cat Fish.

This species may be distinguished from the channel or white cat, the only other forked-tailed species of the genus within our limits, by the more numerous anal rays, about 25 to 35 in number.

It is among the largest of the cat fishes, reaching upwards of 150 pounds in weight. Mr. J. M. Stratton, writes that lake cat fish were a few years ago brought from Lake Erie and placed in Greenwood Lake and Lake Hopatcong. They propagated and a great many were caught in those waters.

### Family SALMONIDÆ.

#### The Salmon.

This family is pre-eminent among food-fishes and therefore has secured a large share of the attention of fish-culturists and anglers. Several species have been introduced within the boundaries of the state and with some promise.

#### *Key to the genera.*

- a. A. 14 to 17. ONCORHYNCHUS
- aa. A. 9 to 12.
  - b. Vomer flat, toothed surface plane, and teeth in alternating rows or in a zig-zag row directly on the bone. SALMO
  - bb. Vomer boat-shaped, shaft strongly depressed, only head toothed. SALVELINUS

#### Genus ONCORHYNCHUS Suckley.

#### The Quinнат Salmon.

**Oncorhynchus tshawytscha** (Walbaum).

#### Quinнат Salmon.



Quinнат Salmon. *Oncorhynchus tshawytscha* (Walbaum).

This fish may be distinguished from the next chiefly by its larger anal fin, containing about 16 rays.

It has been introduced into the Delaware and Raritan basins, but never appeared to flourish. It is an excellent food-fish and reaches a weight of 100 pounds.

*Oncorhynchus tshawytscha* J. Nelson, Rep. Geol. Surv. N. J., II, Zoöl., 1890, p. 690.

### Genus SALMO Linnæus.

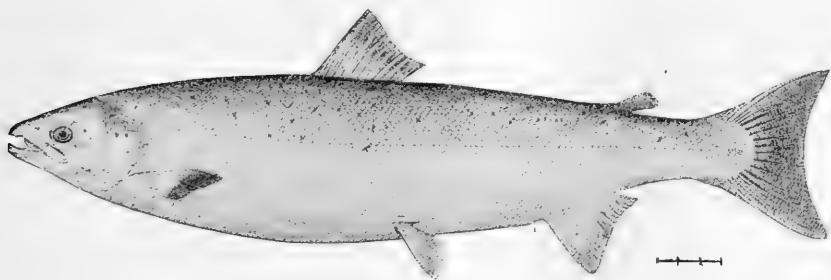
#### The Salmon.

#### *Key to the species.*

- a.* Shaft of vomer with 3 or 4 teeth in a single row, gradually lost from behind forward with advancing age, and head of bone pentagonal and toothless.
  - b.* Marine; larger, more elongate. SALAR
  - bb.* Land-locked; smaller, more plump. SALAR SEBAGO
- aa.* Shaft of vomer with biserial teeth, sometimes zig-zag and a single transverse row on triangular head of bone completing palatine series of teeth. FARIO

### *Salmo salar* Linnæus.

#### Atlantic Salmon. Salmon.



Atlantic Salmon. *Salmo salar* Linnæus.

A handsome large food-fish reaching a weight of 60 pounds. It may be distinguished from the preceding chiefly by the fewer anal rays, which are about 9 in number. Although said to have been formerly abundant in the Hudson, and occurring in small

numbers in the Delaware, its presence in these streams is due to artificial introduction as it is most likely not native south of the New England rivers. I have several records of examples from off Cape May and in the Delaware tide-water. They are said to enter the Delaware and Hudson in April for the purpose of spawning. Mr. J. M. Stratton says that several years ago atlantic salmon were planted in the Delaware River and some were caught a few years later, but at the present time he doubts if any are in New Jersey waters.

*Salmo salar* Abbott, Geol. N. J., 1868, p. 820.—J. Nelson, Rep. Geol. Surv. N. J., II, Zoöl., 1890, p. 691.

***Salmo salar sebago* (Girard).**

Land Locked Salmon.

This presents no characters of structural importance differing from the preceding species. It differed perhaps in habits, smaller size and rather more plump form. It is said to reach a weight of 25 pounds and seldom enters streams. It has been introduced into the lakes in the northern part of the state.

***Salmo fario* Linnæus.**

Brown Trout. Brook Trout. Von Behr Trout.

This species of non-migratory salmon differs from the two preceding chiefly in the well-developed persistent biconical vomerine teeth. Introduced from Europe. It reaches a length of 31 inches.

*Salmo fario* E. Smith, Proc. Linn. Soc. N. Y., IX, 1897, p. 32.

**Genus SALVELINUS Richardson.**

The Charrs.

***Salvelinus alpinus* (Linnæus).**

Saibling.

Head 4; depth  $4\frac{1}{2}$ ; snout 4 in head; eye 4; least depth of caudal peduncle  $2\frac{1}{5}$  in greatest depth of body, and 3 in head.

Maxillary reaching slightly behind orbit, its width nearly  $\frac{1}{4}$  its length. Mandible slightly projecting. Origin of dorsal nearer tip of snout than base of caudal, base of fin 2 in head, longest ray equals pectoral or nearly  $1\frac{1}{2}$  in head, and last ray 3 in head. Adipose fin over last 2 or 3 anal rays, and its length about equal to diameter of iris. Anal base  $2\frac{1}{4}$  in head, and last ray  $\frac{1}{2}$  of longest, which is 2 in head. Caudal deeply forked, middle rays less than  $\frac{1}{2}$  length of outer, which are equal to head without snout. Pectoral reaching almost below origin of dorsal,  $1\frac{1}{2}$  in head. Ventral inserted below fifth or sixth branched dorsal ray and equal to postorbital part of head. Scaly ventral flap not quite 3 in head. Color with about 10 oblong parr marks on side and a few narrow dark blotches simulating half bands on back from near nape to a point behind dorsal. Numerous pale spots along middle of sides, each probably with a vermilion spot during life. Length  $9\frac{3}{5}$  inches. Sterling Lake. (Bean.)

This fish has been introduced from Europe. It is an inhabitant of north-eastern America and is found in cold lakes and mountain streams. It may be distinguished from our brook trout by not having the back marbled with darker, and unspotted, the red spots confined to the side.

*Salvelinus alpinus* Bean, 7th An. Rep. F. Fish and Game Com., N. Y., 1901, p. 347.

### Family ESOCIDÆ.

#### The Pikes.

#### Genus *Esox* Linnæus.

#### The Pikes.

#### *Esox masquinongy* (Mitchill).

#### Muskallunge.

Distinguished easily from our other species by naked cheeks and lower half of opercles.

Largest of the pikes, reaching a length of 8 feet and a weight of 100 pounds or more. It is a native of the Great Lake and

upper Mississippi regions. Mr. J. M. Stratton says that several years ago two muskallunges were brought from Lake Erie and placed in Greenwood Lake. At the time of their liberation in New Jersey waters their weight was about 3 to 5 pounds. A few years later 2 were caught, weighing from 16 to 18 pounds, and as no others have been caught since it is reasonable to presume that these were the 2 which were brought from Lake Erie, evidently not propagating.

### Family CENTRARCHIDÆ.

#### The Sun Fishes.

Several of the larger and more noted gamy species of this family have been introduced with success.

#### *Key to the genera.*

- a.* CENTRARCHINÆ. Dorsal scarcely longer than anal, spines V to VIII. POMOXIS
- aa.* Dorsal much longer than anal.
  - b.* LEPOMINÆ. Body short and deep; scales ctenoid; caudal concave; A. spines V to VIII; lingual teeth in a single patch. AMBLOPLITES
  - bb.* MICROPTERINÆ. Body elongate, depth of adult 3; caudal lunate; A. spines III; lingual teeth obsolete. MICROPTERUS

#### Genus POMOXIS Rafinesque.

#### The Crappies.

The fishes represented in this genus now known from our limits form part of the sub-family *Centrarchinæ*. They differ from all our other sun fishes in having the dorsal fin scarcely longer than the anal.

#### *Key to the species.*

- a.* Dorsal spines VI, rarely V; profile strongly sigmoid. ANNULARIS
- aa.* Dorsal spines VII, rarely VIII; profile less sigmoid. SPAROIDES



**Pomoxis annularis** Rafinesque.

Crappie.

Distinguished from the next by the fewer dorsal spines and more strongly sigmoid upper profile anteriorly.

Introduced from the middle United States and Great Lakes. It abounds in ponds, lakes and sluggish waters. It is difficult to distinguish from the next and is also very variable. Both reach a foot in length and are good food-fishes.

**Pomoxis sparoides** (Lacépède).

PLATE 99.

Calico Bass. Grass Bass. Strawberry Bass. Goggle Eyed Perch.

Dorsal spines VII or VIII and profile less sigmoid than that of the preceding.

It is also apparently an introduction from the Great Lakes and Mississippi valley region. It prefers clear cold water.

*Pomoxys sparoides* Abbott, Nat. Rambles, 1885, p. 478.

*Pomoxys hexacanthus* Abbott, Rep. U. S. F. Com., 1875-76, p. 837.

Genus **AMBLOPLITES** Rafinesque.

The Rock Bass.

**Ambloplites rupestris** (Rafinesque).

PLATE 100.

Rock Bass. Red Eye. Goggle Eye. Mud Sun Fish.

From our sun fishes, belonging to the *Lepominae*, this one approaches nearest the mud sun fish, *Acantharchus*. It differs, however, in the ctenoid scales.

Introduced from the Great Lakes and Mississippi valley. A gamy and valuable food-fish reaching a foot in length.

*Ambloplites rupestris* Abbott, Geol. N. J., 1868, p. 807.—E. Smith, Proc. Linn. Soc. N. Y., IX, 1897, p. 41.

Genus MICROPTERUS Lacépède.

The Black Bass.

The fishes of this genus form a sub-family, *Micropterinae*, differing from all the other species in their elongate form and deeply emarginate dorsal fin.

*Key to the species.*

- a. About 17 rows of scales on cheek; young more or less barred or spotted,  
without black lateral band. DOLOMIEU
- aa. About 10 rows of scales on cheek; young with a dark lateral band. SALMOIDES

*Micropterus dolomieu* Lacépède.

PLATE 101.

Small Mouthed Black Bass.

Mouth smaller than in the next and dorsal less deeply notched.

Introduced from the Great Lakes and Mississippi valley. It is found usually in clear cold water, or cool running streams, and is more highly prized as a game fish than the next. It is good eating.

*Micropterus dolomieu* J. Nelson, Rep. Geol. Surv. N. J., II, Zoöl., 1890, p. 728.

*Micropterus dolomieu* E. Smith, Proc. Linn. Soc. N. Y., IX, 1897, p. 43.

*Micropterus salmoides* (Lacépède).

PLATE 102.

Large Mouthed Black Bass. Large Mouthed Bass. Oswego Bass. Black Bass.

Maxillary of the adult reaching beyond the eye, shorter in the young, and dorsal fin deeply notched.

Introduced from the Great Lakes and Mississippi valley. This is a much larger fish than the preceding, attaining 18 inches in length. It is abundant in lakes or sluggish waters, and is also less active and less esteemed than the preceding.

*Micropterus salmoides* Abbott, Rep. U. S. F. Com., 1875-76, p. 836.—J. Nelson, Rep. Geol. Surv. N. J., II, Zoöl., 1890, p. 727.—E. Smith, Proc. Linn. Soc. N. Y., IX, 1897, p. 44.—Evermann, Recreation, April, 1902, p. 292.

### Family PERCIDÆ.

#### The Perches.

#### Genus STIZOSTEDION Rafinesque.

#### The Wall Eyed Pikes.

#### *Stizostedion vitreum* (Mitchill):

PLATE 103.

#### Wall Eyed Pike. Pike Perch.

This fish may be distinguished from its nearest relative, the yellow perch, chiefly by the presence of the canine teeth, and from the other members of the family by the well developed pseudobranchiæ.

Originally an inhabitant of the Great Lake and Mississippi valley regions this species has been introduced into the Delaware. It is a valuable food-fish reaching a length of 3 feet and a weight of 20 pounds.

*Stizostedium vitreum* J. Nelson, Rep. Geol. Surv., N. J., II, Zoöl., 1890, p. 731.

*Lucioperca vitrea* E. Smith, Proc. Linn. Soc. N. Y., IX, 1897, p. 46.

Family **SERRANIDÆ**.

The Bass.

Genus *Roccus* Mitchill.

The Striped Bass.

***Roccus chrysops*** (Mitchill).

White Bass., Silver Bass.

This differs from the rock or striped bass in having the teeth on the base of the tongue in a single patch, and the large second anal spine, which is  $\frac{1}{3}$  of the length of the head.

Introduced from the Great Lake and Mississippi valley regions, where it inhabits deep still fresh waters, seldom in small streams. It reaches a length of 15 inches.

*Roccus chrysops* E. Smith, Proc. Linn. Soc. N. Y., IX, 1897, p. 46.

## Glossary of Technical Terms Relative to Fishes.

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*Abdominal fins.* With reference to the ventral fins when placed well behind pectorals and the pelvic arch, to which they are attached, not connected with shoulder-girdle.

*Actinosts.* A series of bones at bases of pectoral rays.

*Aculeate.* Slender-pointed.

*Acuminate.* Gradual tapering to a point.

*Adipose eye-lid.* Broad fatty eye-lid of some fishes, sometimes covering most of eye.

*Adipose fin.* Fleishy fin-like projection on the back behind the dorsal fin, as of salmon, catfishes, etc.

*Air-bladder.* A sac placed below the backbone, filled with air, and corresponding to the lungs of higher animals. Air-vessel.

*Alisphenoid.* A small bone on the front side wall of the brain-case.

*Amphicælian.* Double-concave, usually referring to vertebræ.

*Anadromous.* Said of marine fishes which ascend streams to spawn.

*Anal.* With reference to the anus or vent.

*Anal fin.* Fin on median line of body behind vent.

*Anal papilla.* A fleshy projection at vent.

*Anchylosed.* Firmly grown together.

*Angular.* A small bone on back end of lower jaw.

*Antrorse.* Turned forward.

*Anus.* External opening of the intestine.

*Arterial bulb.* Muscular swelling at base of great artery.

*Articular.* Bone of lower jaw supporting the dentary.

*Articulate.* Jointed.

*Atlas.* The first vertebra.

*Atrophy.* Non-development.

*Attenuate.* Long and slender, as if drawn out.

*Auditory capsule.* The lower side swelling of the skull.

*Axis.* Second vertebra.

*Barb.* A small serrature, turned back.

*Barbel.* Usually an elongated fleshy projection.

*Basibranchials.* Lower median series of bones of the gill-arches.

*Basioccipital.* A lower median hind bone of the skull which attaches the atlas.

*Basis cranii.* Bones formed by shelves developed from inner sides of proötics which meet and form a roof to myodome and a floor to brain-cavity.

*Bicuspid.* Two-pointed, usually of teeth.

*Brachial ossicles.* Actinosts.

*Branchia.* Gills.

*Branchiophyls.* Small bones at base of gill-arches.

*Branchiostegals.* Bony rays supporting membranes under the head below the opercular bones.

*Buccal.* Relating to the mouth.

*Caducous.* Soon falling off.

*Cæcal.* Of blind sack-like form.

*Cæcum.* Blind sack-like appendage connected with the alimentary canal at the posterior end of the stomach.

*Canines.* Any conical teeth in jaws longer or larger than the others.

*Cardiform teeth.* Coarse and sharp teeth like wool cards.

*Carinate.* Keeled, usually with reference to a ridge along median line.

*Carotid.* The great artery running to the head.

*Carpus.* The wrist.

*Catadromous.* Said of fresh-water fishes which descend to the sea to spawn.

*Caudal fin.* Fin at or on the tail.

*Caudal peduncle.* Region between anal and caudal, and dorsal and caudal, fins.

*Cavernous.* Containing cavities, either empty or filled with mucous.

*Centrum.* Body of a vertebra.

*Cephalic fins.* Detached part of pectoral on head of certain rays.

*Ceratobranchials.* Bones of branchial arches just below their angle.

*Ceratohyal.* A hyoid bone.

*Chiasma.* Crossing of the optic nerve fibers.

*Chin.* Space at front of lower jaw.

*Ciliated.* Fringed with eyelid-like projections.

*Cirri.* Fringes.

*Claspers.* Male reproductive organs attached to the ventral fins of sharks, skates, etc.

*Clavicle.* Collar-bone, or lower anterior part of shoulder-girdle, not entering arm-socket.

*Compressed.* Flattened laterally.

*Condyle.* Articulating surface of a bone.

*Coracoid.* Hypercoracoid. Principal shoulder-girdle bone.

*Cranial.* Relating to the skull.

*Ctenoid.* Usually of scales with rough edges, due to being minutely spinous or pectinated.

*Cycloid.* Usually of scales with smooth edges, not ctenoid, but concentrically striate.

*Deciduous.* Falling off, or temporary.

*Decurved.* Curved downward.

*Dentary.* Principal bone in front of lower jaw bearing teeth.

*Dentate.* With tooth-like notches. Denticulate.

*Denticle.* A little tooth.

*Depressed.* Flattened vertically.

*Depth.* Usually vertical diameter of body.

*Dermal.* Relating to the skin.

*Diaphanous.* Translucent.

*Distal.* Remote from point of attachment

*Dorsal.* Relating to the back.

*Dorsal fin.* Fin on the back.

*Emarginate.* Slightly forked or notched.

*Endoskeleton.* The skeleton, or inner bony frame-work of the body.

*Enteron.* Alimentary canal.

*Epibranchials.* Bones directly above the angle of the branchial arches.

*Epihyal.* One of the hyoid bones.

*Epipleurals.* Bony rays attached to the ribs and anterior vertebræ, usually touching the skin about the lateral line.

*Erectile.* Susceptible of being raised or erected.

*Ethmoid.* A median bone in the front of the skull.

*Exoccipitals.* Two bones on the back of the skull, one on each side of the foramen magnum.

*Exoskeleton.* Outer skeleton, or such hard parts on the surface of the body as scutes, scales, etc.

*Exserted.* Projecting beyond the general level.

*Extralimital.* Beyond the limits.

*Falcate.* Sickle-shaped.

*Falciform.* Curved like a sickle.

*Fauna.* Animals inhabiting any region considered collectively.

*Femoral.* Relating to the femur, or proximal bone of the hind limb.

*Filament.* A slender thread-like structure.

*Filiform.* Thread-form.

*Fontanel.* An unossified space, as that on top of head covered by membrane.

*Foramen.* A hole or opening.

*Foramen magnum.* Opening in the back of the skull for the passage of the spinal cord.

*Forehead.* Frontal curve of the head.

*Forficatæ.* Scissors-like.

*Fossæ.* Usually grooves in which the nostrils open.

*Frontal bone.* Front bone on top of the head, usually paired.

*Fulcra.* Rudimentary spine-like projections on the front fin-rays of ganoid fishes.

*Furcate.* Forked.

*Fusiform.* Spindle-shaped, or tapering at both ends.

*Ganglion.* A nerve center.

*Ganoid.* Enameled bony scales or plates.

*Gape.* Opening of the mouth.

*Gill-arches.* Bony arches to which gills are attached.

*Gill-openings.* Openings leading to or from the branchiæ.

*Gill-rakers.* Various formed bony appendages along the inner edge of the gill-arch.

*Gills.* Organs for breathing air in the water.

*Glabrous.* Smooth.

*Glossohyal.* Tongue-bone.

## 444 REPORT OF NEW JERSEY STATE MUSEUM.

*Graduated.* Progressing or decreasing in length, usually with reference to spines or rays in series.

*Granulate.* Finely roughened.

*Gular.* Relating to the upper foreneck.

*Hæmal arch.* An arch under a hæmal spine for the passage of a blood-vessel.

*Hæmal canal.* The series of hæmal arches as a whole.

*Hæmal spine.* Lowermost spine of a caudal vertebra.

*Hæmopophyses.* Processes on lower side of an abdominal vertebra.

*Height.* Vertical diameter.

*Heterocercal.* With reference to an unequal tail with the backbone evidently extending into the upper lobe.

*Homocercal.* With reference to a tail evidently unequal or the backbone apparently stopping at the middle of the base of the caudal fin.

*Humerus.* The proximal bone of the fore limb.

*Hyoid.* Relating to the tongue.

*Hyoid apparatus.* Series of bones inside lower jaw supporting the tongue.

*Hyomandibular.* A bone by which the posterior end of the suspensorium articulates with the skull; the supporting element of the suspensorium, mandible, hyoid and opercular bones.

*Hypercoracoid.* Upper of two bones attached to the clavicle indirectly bearing the pectoral fin.

*Hypleural.* Modified last vertebra supporting the caudal fin.

*Hypobranchials.* Branchial bones below the ceratobranchials.

*Hypocoracoid.* Lower of two bones attached to clavicle behind.

*Hypohyals.* Usually four small bones by which the respective sides of the hyoid apparatus are joined.

*Imbricate.* Overlapping.

*Inarticulate.* Not jointed.

*Incisors.* Front cutting-teeth.

*Inferior pharyngeals.* Lower pharyngeals.

*Infraoral.* Below mouth.

*Interhæmals.* Bones to which anal rays are attached.

*Interhæmal spines.* Elements supporting anal fin.

*Interhyal.* Upper hyoid bone attached to hyomandibular.

*Intermaxillaries.* Premaxillaries.

*Intermusculars.* Epipleurals.

*Interneurals.* Bones to which dorsal rays are attached.

*Interneurals spines.* Elements supporting dorsal fin.

*Interorbital.* Between eyes.

*Interopercle.* Membrane bone attached between preopercle and branchiostegals.

*Interspinals.* Bones to which fin-rays are attached. Interspinous bones.

*Isocercal.* With reference to the tail of which the last vertebræ are graduated smaller and ending in median line of caudal fin.

*Isthmus.* Junction, usually between the branchial cavities, of the chest with the throat.



*Jugular.* Relating to the lower throat. Usually with reference to ventral fins inserted in advance of the pectorals.

*Keeled.* Furnished with a ridge along the median line.

*Lacustrine.* Living in lakes.

*Lamellæ.* Plate-like processes.

*Larva.* An immature form which must undergo change of appearance before becoming adult.

*Lateral line.* A series of muciferous tubes along each side of the body forming a raised line.

*Lateral processes.* Parapophyses.

*Lunate.* Form of new moon or crescent-shaped. Usually with reference to a broad and shallow-forked caudal lobe.

*Mandible.* Lower jaw.

*Maxilla.* Upper jaw.

*Maxillaries.* Outermost or hindermost bones of upper jaw.

*Maxillary.* Upper jaw.

*Mesethmoid.* Ethmoid.

*Mesopterygoid.* A suspensorium bone.

*Metapterygoid.* A suspensorium bone.

*Milt.* Testes.

*Molars.* Grinding teeth, usually posterior in the jaws.

*Muciferous.* Producing or containing mucous.

*Myocomma.* A muscular band.

*Myodome.* Cavity under the brain-cavity for the reception of the rectus muscles of the eye.

*Nape.* Neck above, next to the occiput.

*Nares.* Nostrils.

*Nasal plate.* Plate in which nostrils are inserted.

*Neural arch.* Opening through base of neural spine for passage of spinal cord.

*Neural canal.* Neural arches as a whole.

*Neural processes.* A plate rising on each side of the centrum of a vertebra which unites to form a spine.

*Neural spine.* Uppermost spine of a vertebra.

*Nictitating membrane.* Third or inner eyelid, as in sharks, etc.

*Notocord.* A cellular cord, preceding the vertebral column, in the embryo.

*Occipital.* Relating to the occiput.

*Occipital condyle.* Portion of the occipital bone modified to articulate with the atlas.

*Occiput.* Back of head above.

*Ocellate.* Eye-like, usually roundish with a lighter or darker border.

*Oid.* Like, as a suffix, such as Percoid, or perch-like; etc.

*Opercle.* Back membrane-bone on side of head covering branchial cavity.

*Operculum.* Opercle.

*Opercular bones.* Membrane bones on side of head.

*Opercular flap.* Prolonged upper angle of opercle, as in sunfishes.

*Opisthocalian.* Concave behind only, usually referring to ball-and-socket jointed vertebræ.

*Opisthotic.* Bone of skull to which lower limb of post-temporal usually articulates.

*Orbicular.* Nearly circular.

*Orbit.* Eye socket.

*Ossicula auditus.* Ear-bones.

*Osteology.* Study of bones.

*Oviparous.* Producing eggs developed after exclusion from the body, as in most fishes.

*Ovoviviparous.* Producing eggs hatched before exclusion from the body, as in the dog-sharks.

*Ovum.* Egg.

*Palate.* Roof of mouth.

*Palatines.* A pair of membrane bones on roof of mouth, one on each side extending out the band from vomer.

*Palustrine.* Living in swamps.

*Papilla.* A small fleshy projection.

*Parapophyses.* Lateral processes on some abdominal vertebræ to support ribs.

*Parasphenoid.* Bone on roof of mouth following vomer.

*Parietal.* Bone on side of head above.

*Parotic process.* Formed on side, back on the skull, by the pterotic and opisthotic.

*Pectinate.* Toothed like a comb.

*Pectoral.* Relating to the breast.

*Pectoral fins.* Front or upper paired fins corresponding to front limbs of other vertebrates.

*Pelagic.* Living on or in high seas.

*Pelvic girdle.* Bones supporting ventral fins.

*Pelvis.* Bones to which hind limbs, or ventral fins, are attached.

*Peritoneum.* Membrane lining abdominal cavity.

*Pharyngeal bones.* Bones behind gills at beginning of œsophagus, of various forms, usually with teeth. Placed usually as a single pair below and a double pair above.

*Pharyngobranchials.* Upper elements of branchial arches, usually bearing teeth.

*Pharyngognathous.* Having lower pharyngeal bones united.

*Physoclistous.* Having air-bladder closed.

*Physostomous.* Having air-bladder connected by a tube with alimentary canal.

*Pigment.* Coloring matter.

*Pineal body.* A small ganglion in the brain, a rudiment of an optic lobe connected with a third or median eye.

*Pineal eye.* Pineal body.

*Pituitary body.* A small ganglion in the brain.

- Plicate*. Folded so as to show transverse folds or wrinkles.
- Plumbeous*. Lead-colored or dull bluish-gray.
- Polygamous*. Male mating with more than a single female.
- Postclavicle*. A ray composed of one or two bones attached to inner upper surface of clavicle and extending downward.
- Postocular*. Behind eye. Postorbital.
- Post-temporal*. Bone suspending shoulder-girdle from cranium.
- Precoracoid*. Portion of coracoid more or less separated from rest.
- Precoracoid arch*. Arch in front of coracoid in most soft-rayed forms.
- Prefrontals*. Bones forming side projections at front end of skull.
- Premaxillaries*. A bone on each side of front of upper jaw, usually larger than maxillaries and bearing most of teeth.
- Premolars*. Small grinders, or teeth between canines and true molars.
- Precocular*. Before eye.
- Preopercle*. Membrane bone lying in front of opercle, more or less parallel.
- Preorbital*. Usually large membrane bone before eye.
- Procahan*. Concave in front only.
- Procurrent*. Usually of fin with lower rays inserted progressively farther forward.
- Projectile*. Capable of being thrust forward.
- Proötic*. Bone forming front side of brain-case.
- Protractile*. Capable of being drawn forward.
- Proximal*. Nearest.
- Pseudobranchiæ*. Small gills on inner side of opercle.
- Pterotic*. Bone at side process back on skull.
- Pterygoids*. Bones on roof of mouth behind palatines.
- Pubic bones*. Pelvic bones.
- Pubis*. Front and lower part of pelvis.
- Pulmonary*. Relating to lungs.
- Pyloric cæca*. Glandular appendages in form of blind sacs, opening into alimentary canal at the pylorus or junction of stomach with intestine.
- Quadrate*. Bone of suspensorium to which mandible is hinged.
- Quincunx*. Set of 5 arranged ∴.
- Radius*. Outer bone of fore limb.
- Ray*. Cartilaginous rod supporting membrane of a fin.
- Recurved*. Curved upward.
- Reticulate*. Marked like a network.
- Retrorse*. Turned backward.
- Roe*. Ova.
- Rudimentary*. Undeveloped.
- Rugose*. Rough with wrinkles.
- Sacral*. Relating to the sacrum or vertebræ of pelvic region.
- Scapula*. Shoulder-blade, or bone of shoulder-girdle below post-temporal.
- Scapular arch*. Shoulder-girdle.
- Scute*. External bony or horny plate.
- Second dorsal*. Posterior or soft part of dorsal fin when the two parts are separated.

*Septum.* A thin partition.

*Serrate.* Notched like a saw.

*Sessile.* Without a stem.

*Setaceous.* Bristly.

*Setiform.* Bristle-like.

*Shaft.* Stiff axis.

*Shoulder-girdle.* Bony girdle back of head forming attachment for front limbs.

*Soft dorsal.* Posterior part of dorsal fin when composed of soft rays.

*Soft rays.* Articulating rays of fin, usually branched.

*Spatulate.* Spoon-shaped.

*Sphenoid.* Basal bone of skull.

*Sphenotic.* Side bone of skull.

*Spine.* A sharp projecting point. When in fin usually unbranched, inarticulate and more or less stiff.

*Spinous dorsal.* Front part of dorsal fin when composed of spinous rays.

*Spiracles.* Openings in head and neck, as in sharks, skates, etc.

*Stellate.* Star-like, or with radiating ridges.

*Striate.* Striped or streaked.

*Sub.* Part, less than, not quite, under, somewhat, etc.

*Subcaudal.* Under the tail.

*Subopercle.* Bone below opercle, suture of connection hidden by scales.

*Suborbital.* Below the eye.

*Suborbital stay.* A bone extending from one of the suborbital bones across the cheek towards the preopercle.

*Subulate.* Awl-shaped.

*Superciliary.* Relating to above the eyebrow.

*Superior pharyngeals.* Pharyngeals.

*Supplemental maxillary.* A small bone along upper edge of maxillary.

*Supraclavicle.* Bone interposed between clavicle and post-temporal.

*Supraoccipital.* Bone at back of skull above, usually with a raised crest above.

*Supraoral.* Above the mouth.

*Supraorbital.* Above the eye.

*Suprascapular.* Post-temporal, or bone joining shoulder-girdle with the skull.

*Suspensorium.* Chain of bones from hyomandibular to palatines.

*Suspensory bones.* Bones fastening lower jaw to skull.

*Suture.* Line of union of two bones.

*Symphysis.* Point of junction of two parts, of lower jaw as tip of chin.

*Symplectic.* Bone that keys together the hyomandibular and quadrate behind.

*Synonym.* A different word with the same or similar meaning.

*Synonymy.* A collection of different names for the same group, species, or thing.

*Tail.* Usually part of body posterior to the anal fin, sometimes posterior to vent.

*Temporal.* Relating to the temples.

*Terete.* Cylindrical and tapering.

*Terminal.* At the end.

*Tessellated.* Marked with little checks or squares like mosaic work.

*Thoracic.* Relating to the chest.

*Thoracic fins.* So called when attached immediately below the pectorals, as in the perch, etc., the pelvic bones being fastened to the shoulder-girdle.

*Trenchant.* Compressed to a sharp edge.

*Truncate.* Abrupt, as if cut off square.

*Tubercle.* A small excrescence like a pimple.

*Type.* (Of the genus.) A species on which a genus is based.

*Type.* (Of the species.) A particular specimen on which the original specific description was based.

*Type locality.* The particular place or locality where the type specimen was found.

*Typical.* Of a structure most usual in a given group.

*Ultimate.* Last or farthest.

*Vent.* Anus.

*Ventral.* Relating to the abdomen.

*Ventral fins.* Paired fins below or behind the pectorals corresponding to the hind limbs of other vertebrates.

*Ventral plates.* A row of plates along belly between throat and vent.

*Ventricle.* One of the thick-walled chambers of the heart.

*Versatile.* Capable of being turned either way.

*Vertebra.* One of the spinal column bones.

*Verticle.* Up and down.

*Verticle fins.* Fins of the median line of the body as the dorsal, anal and caudal.

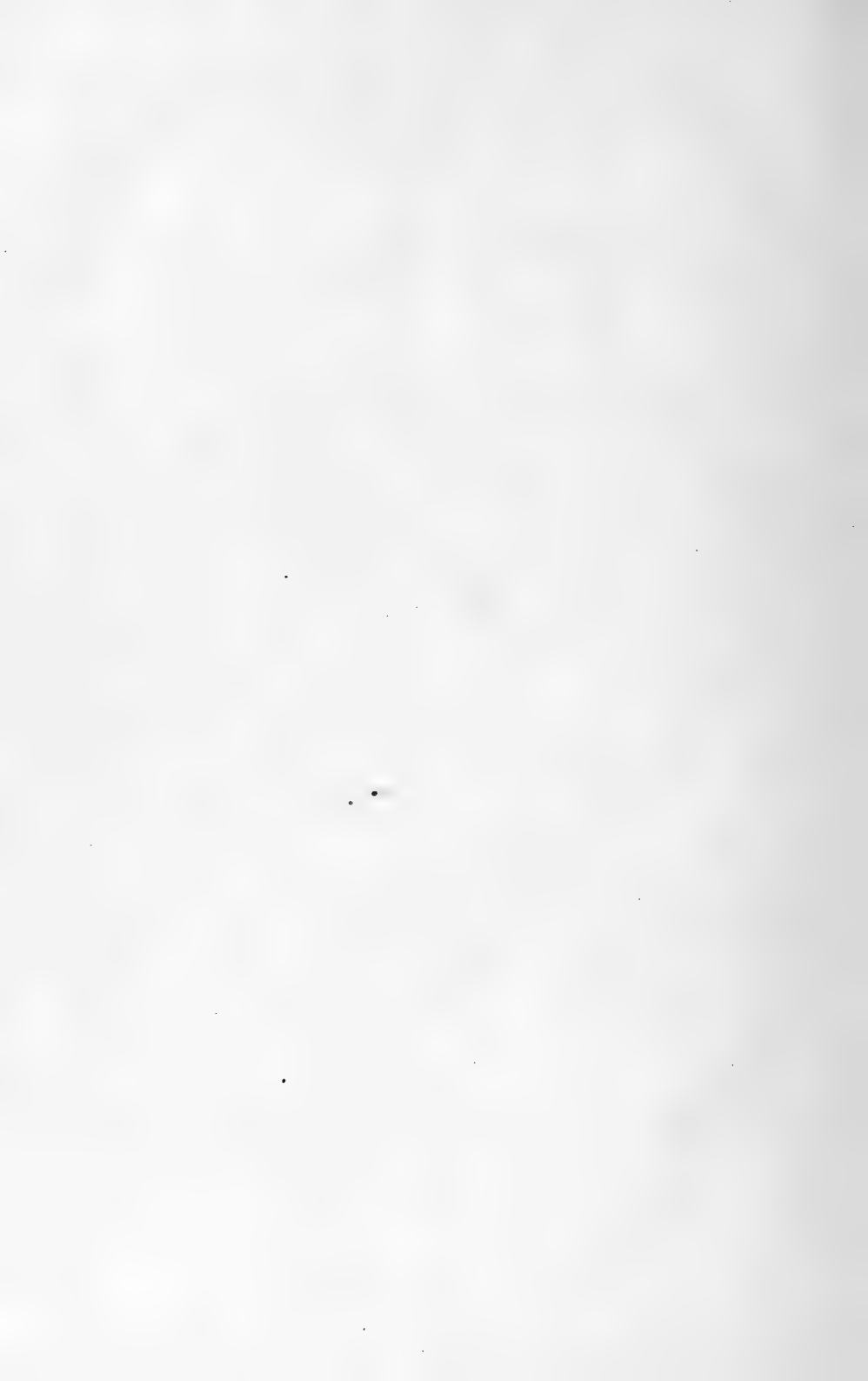
*Villiiform.* Usually of slender crowded teeth in velvety bands.

*Viscous.* Slimy.

*Viviparous.* Bringing forth living young.

*Vomer.* A bone immediately behind maxillaries in front part of roof of mouth.

*Zygapophyses.* Points of bone affording more or less definite articulation to the vertebræ.



## Index to Technical Names.

A	PAGE.		PAGE.
Abramis chrysoleucas roseus, .....	138	alepidotum, Gobiosoma, .....	386
chrysoleucas, .....	137	alepidotus, Gobius, .....	386
Acantharchus, .....	277, 278, 437	alleterata, Pelamys, .....	241
pomotis, .....	278, 280	alleterata, Gymnosarda, .....	241
Acantharcus pomotis, .....	280	Alopias, .....	53
acanthias, Squalus, .....	67, 68, 416	vulpes, .....	53
Acanthocottus æneus, .....	373	Alopiidæ, .....	51, 53
mitchilli, .....	373	Alosa, .....	92, 99
octodecim-spinosus, ..	374	cyanonoton, .....	98
virginianus, .....	374	mattowaca, .....	95
Acanthopteri, .....	83, 201, 424	menhaden, .....	104
Acanthurus phlobotomus, .....	356	præstabilis, .....	102
Achirus, .....	397	sapidissima, .....	99
fasciatus, .....	397, 398	teres, .....	93
mollis, .....	398	tyrannus, .....	98
Acipenser, .....	84, 85	alpinus, Salvelinus, .....	434, 435
brevirostris, .....	87	altus, Priacanthus, .....	313
brevirostrum, .....	85, 86, 87	Pseudopriacanthus, .....	312
oxyrhynchus, .....	86	Alutera, .....	358, 359
oxyrinchus, .....	86	cuspidata, .....	359
sturio, .....	85, 86	schæpfi, .....	359
sturio oxyrhynchus, .....	86	Ambloplites, .....	436, 437
Acipenseridæ, .....	84	pomotis, .....	280
Actinopteri, .....	50, 82	rupestris, .....	437, 438
acutirostris, Anguilla, .....	121	Ameiurus, .....	164, 166, 173, 431
adpersus, Ctenolabrus, .....	344	catus, .....	166, 166, 167
Tautogolabrus, ..	335, 343, 344	erebennus, .....	169
æglefinis, Melanogrammus, .....	417	lacustris, .....	431
æglefinus, Melanogrammus, .....	417	natalis prosthistius, ...	166, 167
æglepinus, Melanogrammus, .....	417	nebulosus, ...	166, 169, 171, 288
Æluriichthys marinus, .....	166	americana, Aythya, .....	196
æneus, Acanthocottus, .....	373	Merone, .....	308
Myoxocephalus, .....	373	Morone, .....	129, 308
æstivalis, Clupea, .....	98, 99	Morrhua, .....	416
Agonidæ, .....	368, 376	Raia, .....	73
Ailurichthys marinus, .....	166	Stilbe, .....	138
all-a-cauda, Echeneis, .....	387	Tautoga, .....	346
albicauda, Echeneis, .....	388	americanus, Ammodytes, .....	410, 411
albidus, Amiurus, .....	167	Esox, .....	175, 177
Pimelodus, .....	167	Hemitripterus, .....	375, 376
albula, Mugil, .....	219, 220	Hippoglossus, .....	393
Alburnellus amœnus, .....	149	Leucosomus, .....	138
Alburnops hudsonius, .....	142	Lophius, .....	426
Alburnus amœnus, .....	149	Lucius, .....	177
alburnus, Menticirrus, .....	336	Luxilus, .....	138
Umbrina, .....	338	Menticirrus, .....	335
Alectis, .....	250, 259	Merganser, .....	398
crinitus, .....	259	Odontaspis, .....	53
		Petromyzon, .....	50

# 452 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.		PAGE.
americanus, Pleuronectes, .....	396	Aphrodederus sayanus, .....	276
Pseudopleuronectes, .....	396	Aplodinotinae, .....	329, 339
Roccus, .....	308	Apodes, .....	83, 118
Sophius, .....	426	Apodontis maculatus, .....	245
Squalus, .....	68	Apomotis cyanellus, .....	291
Amiurus albidus, .....	167	ischyrus, .....	291
atrarius, .....	171	obesus, .....	282, 285
dekayi, .....	171	phenax, .....	291
lynx, .....	167	appendix, Ichthelis, .....	293
natalis, .....	169	Ichthyomyzon, .....	50
prosthius, .....	168, 169	Pomotis, .....	293
Ammodytes, .....	410	Archosargus, .....	321, 323
americanus, .....	410, 411	probatocephalus, .....	323, 325
Ammodytidae, .....	398, 409	arcuatus, Pomacanthus, .....	353, 354
amoenus, Alburnellus, .....	149	Ardea herodias, .....	196
Alburnus, .....	149	argenteus, Eucinostomus, .....	326
Minnilus, .....	146	Gerres, .....	326
Notropis, .....	139, 148	Lepturus, .....	247
Anacanthini, .....	83, 413	argentatus, Larus, .....	196
analostana, Cliola, .....	143	Argentinidae, .....	90, 114
analostanus, Hybopsis, .....	143	Argyrea notata, .....	217
Hypsilepis, .....	143	Argyreus capillaris, .....	261
Notropis, .....	138, 142, 196	Argyreus atronatus, .....	153
Anarhichadidae, .....	398, 404	nasutus, .....	151
Anarhichas, .....	405	argyritis, Hybognathus, .....	129
lupus, .....	405	argyroleuca, Corvina, .....	333
Anarrhichas lupus, .....	405	argyrophanes, Engraulis, .....	109
Anchovia, .....	108	argyrops, Stenotomus, .....	323
brownii, .....	109, 111	Pagrus, .....	323
duodecim, .....	109, 111	arenosus, Stenotomus, .....	323
eurystole, .....	108, 109	Aspidophoroides, .....	377
mitchilli, .....	109, 110, 112, 214	monopterygius, .....	377
Angelichthys, .....	350, 354	Asterospondyli, .....	51
ciliaris, .....	354	Astrosopus, .....	399
Anguilla, .....	119	anoplus, .....	402
acutirostris, .....	121	guttatus, .....	399, 401, 402
chrysypa, .....	119, 193	y-graecum, .....	399
chrysypa, .....	121	Atherinidae, .....	212
macrocephala, .....	121	Atherinopsis notatus, .....	217
rostra, .....	121	atrarius, Amiurus, .....	171
rostrata, .....	121	atromaculatus, Semotilus, .....	130, 132, 134
tenuirostris, .....	121	atronatus, Argyreus, .....	153
vulgaris, .....	121	Cyprinus, .....	153
anguillaris, Zoarces, .....	406, 407	Rhinichthys, .....	149, 151, 153, 302
Anguillidae, .....	118	aurantiacus, Ceratacanthus, .....	359
Anisotremus, .....	318, 319	auratus, Carassius, .....	430
virginicus, .....	319	Mullus, .....	327
annularis, Pomoxis, .....	436, 437	aureus, Eupomotis, .....	297
annulata, Melanura, .....	183	Pomotis, .....	297
anoplos, Upsilonphorus, .....	400	auriga, Dules, .....	310, 311
anoplus, Astrosopus, .....	402	auritus, Lepipomus, .....	293
Antennariidae, .....	424, 426	Lepomis, 146, 279, 282, 292, 293,	
Antennarius gibbus, .....	427	299.	
variegatus, .....	427	Pomotis, .....	293
Apeltes, .....	224, 227, 276	Aythya americana, .....	196
quadracus, .....	227, 228		
Apeltinae, .....	224		
Aphrodederus sayanus, .....	276		
Aphredoderidae, .....	235, 274		
Aphredoderus, .....	275		
sayanus, .....	275, 276		

## B

Bairdiella, .....	329, 332
chrysura, .....	332, 333
punctata, .....	333



	PAGE.
Balistes, .....	357
carolinensis, .....	357
Balistidæ, .....	356, 358
barracuda, Sphyræna, .....	221
Batoidei, .....	51
Batrachoididæ, .....	411, 424
Batrachoides variegatus, .....	412
Batrachns tau, .....	412
Batrachus tau, .....	412
variegatus, .....	412
Belone longirostris, .....	205
truncata, .....	205
beryllina cerea, Menidia, .....	215
biaculeatus, Gasterosteus, .....	226
bifrenata, Hemitremia, .....	140
Hybopsis, .....	140
Notropis, .... 138, 139, 140, 146	
bilinearis, Merluccius, .....	422
birostris, Manta, .....	80, 82
bispinosus, Gasterosteus, .....	225
blackfordii, Lutjanus, .....	315
Lutjanus, .....	317
Blenniidæ, .....	398, 402
Blennius, .....	402, 403
fucorum, .....	403
Blepharichthys crinitus, .....	259
Bodianus triourus, .....	314
Boleichthys, .....	297, 302
fusiforme, .....	304
fusiformis, .....	279, 302
Boleosoma, .....	297, 299
fusiforme, .....	304
olmstedii, .....	302
nigrum olmstedii, .....	299
bonasus, Rhinoptera, .....	79
borealis, Sphyræna, .....	221, 222, 223
bosci, Gobiosoma, .....	386
bostoniensis, Catostomus, .....	158
Botaurus lentiginosus, .....	196
Bothus maculatus, .....	392
Brama, .....	127, 135
crysoleucas, 135, 146, 193, 279, 282, 288.	
crysoleucas versicolor, .... 135, 138	
brama, Cyprinus, .....	135
brevirostris, Acipenser, .....	87
Huso, .....	87
brevirostrum, Acipenser, .....	85, 86, 87
Brevoortia, .....	56, 92, 103
menhaden, .....	104
tyrannus, .....	103, 104
broccus, Canthorinus, .....	358
Brosme, .....	421
Brosmius, .....	422
Brosme, .....	414, 421
brosme, .....	421
Brosminæ, .....	414
Brosmius brosmæ, .....	422
browni, Stoleporus, .....	110
brownii, Anchovia, .....	109, 111

	PAGE.
<i>Bryttus chaetodon</i> , . . . . .	288
<i>obesus</i> , . . . . .	284
<i>punctatus</i> , . . . . .	282
<i>bullaris</i> , <i>Cyprinus</i> , . . . . .	132
<i>Semotilus</i> , . . . . .	130, 132
<i>Butorides virescens</i> , . . . . .	196

## C

caeruleus, Carcharias, .....	63
Ctenolabrus, .....	344
Squalus, .....	63
callarias, Gadus, .....	416
camelinus, Tetrasomus, .....	360
canada, Elacata, .....	268
canadus, Rachycentron, .....	267
canis, Cynais, .....	60, 66
Galeus, .....	60
Mustelus, .....	60
Canthorinus broccus, .....	358
massachusettsensis, .....	358
segnifer, .....	358
capillaris, Argyreiosus, .....	261
Capricus carolinensis, .....	357
caprodes, Percina, .....	299
Carangidæ, .....	235, 247, 265
Caranginæ, .....	250
Carangus hippos, .....	255
Caranx, .....	250, 254
chrysos, .....	255, 258
crysos, .....	254, 256
hippos, .....	254, 255
latus, .....	254, 258
Carassius, .....	429, 430
auratus, .....	430
Carcharhinus, .....	59, 61, 65
milberti, .....	61, 62, 66
obscurus, .....	61, 62
Carcharias, .....	52
caeruleus, .....	63
littoralis, .....	52
obscurus, .....	62
Carchariidæ, .....	51
carinatus, Molacanthus, .....	369
carolina, Lichia, .....	264
carolinensis, Balistes, .....	357
Capricus, .....	357
Cynoscion, .....	332
Halatractus, .....	253
carolinus, Prionotus, .....	380, 382
Trachinotus, 214, 262, 263, 337	
Trachynotus, .....	264
carpio, Cyprinus, .....	430
Carpiodes cyprinus, .....	164
cataractæ, Rhinichthys, .....	149, 150
Catostomatidæ, .....	125, 154
Catostomus, .....	145, 155
bostoniensis, .....	158
commersoni, .....	158
commersonii, .....	158

# 454 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.		PAGE.
Catostomus, commersonnii, .....	155, 162	chrysoleucas roseus, Abramis, .....	138
communis, .....	158	Chatæssus insociabilis, .....	107, 108
gibbosus, .....	163	signifer, .....	103
Hylomyzon nigricans, ...	159	Chilomycterus, .....	365, 366
macrolepidotus, .....	163	fuliginosus, .....	368
nigricans, .....	155, 158	geometricus, .....	368
teres, .....	158	schœpfi, .....	367
catus, Ameiurus, .....	166	schœpfi, .....	366
Amiurus, .....	167	Chloroscombrinæ, .....	251
Caudina, .....	95	Chloroscombrus, .....	251, 261
Centrarchidæ, .....	235, 276, 436	chrysurus, .....	261
Centrarchinæ, .....	436	Chondrostei, .....	83, 84
Centrarchus pomotis, .....	280	Chondrostomatinae, .....	126
Centrolophidæ, .....	235, 271	chrisypa, Anguilla, .....	119, 193
Centropristes, .....	305, 308	chromis, Pogonias, .....	339
furvus, .....	310	chrysoleucus, Notemigonus, .....	137
nigrescens, .....	310	chrysops, Roccus, .....	440
nigricans, .....	310	Stenotomus, .....	321, 322
striatus, .....	308, 310, 335	chrysopteron, Hæmulon, .....	320
centroura, Dasybatus, .....	76	chrysopterus, Orthopristis, .....	319, 320
centrurus, Dasyatis, .....	77	chrysos, Caranx, .....	255, 258
cepediana, Megalops, .....	108	chrysura, Bairdiella, .....	332, 333
cepedianum, Dorosoma, .....	105, 108	chrysurus, Chloroscombrus, .....	261
Dorysoma, .....	108	chrysypa, Anguilla, .....	121
Cephalacanthidæ, .....	379, 383	chuss, Phycis, .....	418, 420, 421
Cephalacanthus, .....	384	ciliaris, Angelichthys, .....	354
volitans, .....	384, 385	Holacanthus, .....	355
Cephaloptera giorna, .....	81, 82	Zoarces, .....	407
vampyrus, .....	82	Citharichthys microstomus, .....	393
cephalus, Mugil, .....	218, 219	Clininæ, .....	402
Ceratæacanthus aurantiacus, .....	359	Clinostomus funduloides, .....	134, 135
Ceratoptera vampyrus, .....	82	margarita, .....	135
Cestracion, .....	64	Cliola analostana, .....	143
subarcuatus, .....	66	chalybæa, .....	148
tiburo, .....	64, 65	hudsonia, .....	142
zygena, .....	64, 65	procne, .....	141
Cestraciontidæ, .....	51, 64	storeriana, .....	142
Cetorhinidæ, .....	51, 57	Clupanodon, .....	92, 102
Cetorhinus, .....	57	oglinum, .....	102
maximus, .....	57, 59	thrissa, .....	103
Chænobryttus phenax, .....	291	Clupea, .....	92, 93
Chænopsetta ocellaris, .....	395	æstivalis, .....	98, 99
Chætodipterus, .....	348	elongata, .....	93
faber, .....	348	harengus, .....	93
Chætodon, .....	350	mediocris, .....	95, 98
chætodon, Bryttus, .....	288	pseudoharengus, .....	97
Mesogonistius, 146, 148, 285, 288		sadina, .....	93
Pomotis, .....	287, 288	sapidissima, .....	101
Chætodon maculocinctus, .....	351	Clupeidæ, .....	90, 92
ocellatus, .....	350	Clupeinæ, .....	92
striatus, .....	350, 351	Clupeoidea, .....	90
Chætodontidæ, .....	347, 349, 355	cœmicus, Pœcilichthys, .....	304
Chætodontinæ, .....	350	colias, Scomber, .....	237, 239, 240
chalybæa, Cliola, .....	148	Colocephali, .....	118
chalybæus, Notropis, 139, 145, 148, 282, 288,		comatus, Cypselurus, .....	211
abbotti, Notropis, 139, 146, 147, 162.		commersoni, Catostomus, .....	158
chamæleonticeps, Lopholatilus, .....	340	commersonii, Catostomus, .....	158
chantenay, Raia, .....	73, 75	commersonnii, Catostomus, .....	155, 162
		communis, Catostomus, .....	158
		complanatus, Unio, .....	129

	PAGE.
Conger conger, .....	123
occidentalis, .....	123
conger, Conger, .....	123
Leptocephalus, .....	122
cornubica, Lamna, .....	56
cornutus, Hypsilepis, .....	145
Luxilus, .....	145
Minnilus, .....	145
Notropis, .....	139, 143
corporalis, Cyprinus, .....	132
Semotilus, .....	132, 133
Corvina argyroleuca, .....	333
Coryphæna, .....	273
hippurus, .....	273, 274
leseurii, .....	274
Coryphænidæ, .....	235, 272
Cottidæ, .....	369, 371
Cottinæ, .....	372
Cottus gracilis, .....	373
octodecimsipinosus, .....	374
Craniomi, .....	202, 379
crassus, Lepidosteus, .....	89
crinitus, Alectis, .....	259
Blepharichthys, .....	259
cromis, Pogonias, .....	338, 339
crysoleucas, Abramis, .....	137
Brama, 135, 146, 193, 279, 282, 288. versicolor, Brama, .....	135, 138
crysos, Caranx, .....	254, 256
Ctenolabrus adpersus, .....	344
cæruleus, .....	344
curema, Mugil, .....	218, 219, 220
cuspidata, Alutera, .....	359
cyanelus, Apomotis, .....	291
cyanonoton, Alosa, .....	98
Pomolobus, .....	94, 98
Cybium maculatum, .....	245
Cyclopteridæ, .....	369, 371
Cyclopterus, .....	378
lumpus, .....	378, 379
Cyclospendyli, .....	51
Cyclostomes, .....	48
Cynais, .....	59, 60
canis, .....	60, 66
Cynoscion, .....	69, 329, 329
carolinensis, .....	332
maculatus, .....	332
nebulosus, .....	329, 331
Cynoscion regalis, .....	329, 331, 332
Cyprinidæ, .....	125, 429
Cyprinodon, .....	184, 188, 198
ovinus, .....	201
parvus, .....	198
variegatus, .....	198, 201
Cyprinodontinæ, .....	184
Cyprinus, .....	429, 430
atronsus, .....	153
brama, .....	135
bullaris, .....	132

	PAGE.
Cyprinus carpio, .....	430
corporalis, .....	132
cyprinus, Carpiodes, .....	164
Cypselurus, .....	211
comatus, .....	211
fercatus, .....	212
furcatus, .....	211
heterurus, .....	211

5

Dactylopterus volitans, .....	384
Dasybatidae, .....	51, 75
Dasybatus, .....	72, 75, 76
centrourea, .....	76
centrurus, .....	77
hastata, .....	76, 77
say, .....	76, 77
Decapterus, .....	250, 254
punctatus, .....	254
dekayi, Amiurus, .....	171
Isuropsis, .....	55
Isurus, .....	54, 56
Pygosteus, .....	225
Scomber, .....	245
dentatus, Paralichthys, .....	393, 395
Desmognathus fusca, .....	183
diaphanes, Raia, .....	73
diaphanus, Fundulus, 184, 193, 196, 279, 288, .....	
Diodon fuliginosus, .....	368
maculo-striatus, .....	367
pilosus, .....	366
Diodontidae, .....	361, 365
Diplectrum formosum, .....	318
Discocephali, .....	202, 386
dolomiei, Micropterus, .....	438
dolomieu, Micropterus, .....	438
Dorosoma, .....	105
cepedianum, .....	105, 108
Dorosomatidae, .....	90, 105
Dorysoma cepedianum, .....	108
ductor, Naucrates, .....	251
Dules, .....	305, 310
auriga, .....	310, 311
dumerili lalandi, Seriola, .....	253
duodecim, Anchovia, .....	109, 111
Engraulis, .....	112
Dussumieriine, .....	92

## E

Echeneididae, .....	387
Echeneis, .....	387
alba-cauda, .....	387
albicauda, .....	388
naucrates, .....	388
remora, .....	389
eglantiera, Raia, .....	73
Raja, .....	70, 72, 73
Elacate canada, .....	268
niger, .....	268
Elasmobranchii, .....	50



	PAGE.
fusiforme, <i>Boleichthys</i> , .....	304
<i>Boleosoma</i> , .....	304
<i>Hololepis</i> , .....	304
<i>Pœcilichthys</i> , .....	304
fusiformis, <i>Boleichthys</i> , .....	279, 302

## G

<i>Gadidæ</i> , .....	413
<i>Gadinæ</i> , .....	413
<i>Gadus</i> , .....	414, 416
<i>callarias</i> , .....	416
<i>monhua</i> , .....	416
<i>morruhua</i> , .....	416
<i>Galeichthys marinus</i> , .....	166
<i>Galeidæ</i> , .....	51, 59
<i>Galeinæ</i> , .....	59
<i>Galeus</i> , .....	59, 61
<i>canis</i> , .....	69
<i>tigrinus</i> , .....	61
<i>gallus</i> , <i>Selene</i> , .....	261
<i>Gambusia</i> , .....	198
<i>Ganoidei</i> , .....	83
<i>Gasterosteidæ</i> , .....	223, 229
<i>Gasterosteinaæ</i> , .....	224
<i>Gasterosteus</i> , .....	224, 225
<i>biaculeatus</i> , .....	226
<i>bispinosus</i> , .....	225
<i>noveboracensis</i> , .....	226
<i>quadracus</i> , .....	228
<i>Gastrophysus turgidus</i> , .....	365
<i>geminatus</i> , <i>Hypleurochilus</i> , .....	403
<i>geometricus</i> , <i>Chilomycterus</i> , .....	368
<i>Gerres argenteus</i> , .....	326
<i>Gerridæ</i> , .....	236, 325
<i>gibba</i> , <i>Pterophryne</i> , .....	426, 427
<i>gibbus</i> , <i>Antennarius</i> , .....	427
<i>Antostomus</i> , .....	163
<i>Eupomotis</i> , .....	282, 295, 299
<i>Lepomis</i> , .....	296
<i>gigas</i> , <i>Ephippus</i> , .....	349
<i>giorna</i> , <i>Cephaloptera</i> , .....	81, 82
<i>glaucus</i> , <i>Isuropsis</i> , .....	55, 56
<i>gladius</i> , <i>Tylosurus</i> , .....	206
<i>Xiphias</i> , .....	248, 249
<i>gloriosus</i> , <i>Enneacanthus</i> , 193, 146, 280, 284, 288, .....	385
<i>Gobiidæ</i> , .....	202
<i>Gobioidei</i> , .....	386
<i>Gobiosoma</i> , .....	386
<i>alepidotum</i> , .....	386
<i>bosci</i> , .....	386
<i>Gobius alepidotus</i> , .....	386
<i>gracilis</i> , <i>Cottus</i> , .....	373
<i>viscosa</i> , <i>Uranidea</i> , .....	372
<i>Grammichthys lineatus</i> , .....	398
<i>griseus</i> , <i>Lutianus</i> , .....	315, 316, 317
<i>grex</i> , <i>Scomber</i> , .....	240
<i>gula</i> , <i>Eucinostomus</i> , .....	325

	PAGE.
<i>gunnellus</i> , <i>Pholis</i> , .....	404
<i>guttatus</i> , <i>Astroscoptes</i> , .....	399, 401, 402
<i>Enneacanthus</i> , .....	282
<i>Percopsis</i> , .....	274
<i>Upsilonphorus</i> , .....	402
<i>Uranoscoptes</i> , .....	402
<i>Gymnodontes</i> , .....	202, 361
<i>Gymnosarda alletterata</i> , .....	241
<i>Gymnothorax</i> , .....	124
<i>ocellatus</i> , .....	124
<i>Gyrinidæ</i> , .....	132
<i>gyrinus</i> , <i>Noturus</i> , .....	172
<i>Schilbeodes</i> , .....	171, 172, 173

## H

<i>Hæmulidæ</i> , .....	236, 317
<i>Hæmulon</i> , .....	318
<i>chrysopteron</i> , .....	320
<i>formosum</i> , .....	319
<i>plumieri</i> , .....	318
<i>Halatractus carolinensis</i> , .....	253
<i>Haplodoci</i> , .....	202, 411
<i>Haplomi</i> , .....	83, 174, 203
<i>Hardrargira flavula</i> , .....	188
<i>Hardrargyra majalis</i> , .....	188
<i>harengus</i> , <i>Clupea</i> , .....	93
<i>Harpuridæ</i> , .....	347, 355
<i>Harpurus</i> , .....	356
<i>hepatus</i> , .....	356
<i>hastata</i> , <i>Dasybatus</i> , .....	76, 77
<i>Pastinaca</i> , .....	77
<i>Trygon</i> , .....	77
<i>Hemibranchii</i> , .....	201, 223
<i>Hemiramphidæ</i> , .....	203, 207
<i>Hemirhamphus macrorhynchus</i> , .....	210
<i>roberti</i> , .....	209
<i>Hemitripterinaæ</i> , .....	372
<i>Hemitripterus</i> , .....	372, 375
<i>americanus</i> , .....	375, 376
<i>Hemitremia bifrenata</i> , .....	140
<i>hepatus</i> , <i>Harpurus</i> , .....	356
<i>heptagonus</i> , <i>Hippocampus</i> , .....	234
<i>herodias</i> , <i>Ardea</i> , .....	196
<i>heteroclitus</i> , <i>Fundulus</i> , .....	193
<i>macrolepidotus</i> , <i>Fundulus</i> , .....	184, 188, 196, 201
<i>Heterosomata</i> , .....	202, 389
<i>heterurus</i> , <i>Cypselurus</i> , .....	211
<i>Exocætus</i> , .....	211
<i>hexacanthus</i> , <i>Pomoxys</i> , .....	437
<i>Hexanemathichthys felis</i> , .....	166
<i>Hippocampus</i> , .....	231, 233
<i>heptagonus</i> , .....	234
<i>hudsonius</i> , .....	233, 234
<i>punctulatus</i> , .....	233, 234
<i>Hippoglossus</i> , .....	390, 393
<i>americanus</i> , .....	393
<i>hippoglossus</i> , .....	393

# 458 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.
hippos, Carangus, .....	255
Caranx, .....	254, 255
Paratractus, .....	255
hippurus, Coryphæna, .....	273, 274
hispidus, Monacanthus, .....	358
Stephanolepis, .....	358
histrio, Pterophryne, .....	426, 427
Holacanthus ciliaris, .....	355
Hololepis erochrous, .....	304
fusiforme, .....	304
hudsonia, Ciliola, .....	142
hudsonius, Alburnops, .....	142
Hippocampus, .....	233, 234
Hybopsis, .....	141
hudsonius amarus, Notropis, 128, 138, 141	
Huso brevirostris, .....	87
Hybognathus, .....	126, 127
argyritis, .....	129
nitidus, .....	129
nuchalis, .....	128, 129
nuchalis regius, ....	127, 129
osmerinus, .....	128, 129
regius, .....	128, 129
Hybopsis, .....	127, 153
analostanus, .....	143
bifrenatus, .....	140
hudsonius, .....	141
kentuckiensis, .....	153
phænna, .....	141
procne, .....	140
Hyborhynchus notatus, .....	129
Hydrargyra flavula, .....	193
luciae, .....	196
swampina, .....	196
Hylomyzon nigricans, .....	159
Hypentelium nigricans, .....	159
Hypleurochilus, .....	402, 403
geminatus, .....	403
Hyporhamphus, .....	208
unifasciatus, .....	208
Hypsilepis analostanus, .....	143
cornutus, .....	145
kentuckiensis, .....	143

## I

Ichthelis appendix, .....	293
incisor, .....	294
rubricauda, .....	293
Ichthyomyzon appendix, .....	50
Ictalurinae, .....	164
Ictalurus, .....	431
punctatus, .....	431
Ichthæurus punctatus, .....	431
Ilarchidæ, .....	347
incisor, Ichthelis, .....	294
Pomotis, .....	294
Iniomi, .....	90
insignis, Schilbeodes, .....	171, 172, 173
insociabilis, Chatessus, .....	107, 108

	PAGE.
ischyrus, Apomotis, .....	291
Isognatha oceanica, .....	123
Isospondyli, .....	83, 90
Isoopsis dekeyi, .....	55
glaucus, .....	55, 56
Isurus, .....	54
dekeyi, .....	54, 56

## J

Jugulares, .....	202, 398
jamaicensis, Urolophus, .....	76

## K

kentuckiensis, Hybopsis, .....	153
Hypsilepis, .....	143
Kirtlandia, .....	213, 214
vagrans laciniata, .....	213

## L

Labrax lineatus, .....	307
mucronatus, .....	308
Labrus palladus, .....	294
tautoga, .....	346
Labridæ, .....	342, 346
laciniata, Menidia, .....	214
Lactophrys, .....	360
trigonus, .....	360
lacustris, Ameiurus, .....	431
lævigatus, Lagocephalus, .....	362, 364
lævis, Raia, .....	75
lævis, Raja, .....	70, 73
Lagocephalus, .....	362
lævigatus, .....	362, 364
Lagodon, .....	321, 323
rhomboides, .....	323
lalandi, Seriola, .....	251, 253
Lamna, .....	54, 56
cornubica, .....	56
punctata, .....	55
Lamnida, .....	51, 54
Larus argentatus, .....	196
Latilidæ, .....	236, 339
latus, Caranx, .....	254, 258
Leiostomus, .....	69, 329, 334
obliquus, .....	335
xanthurus, .....	334, 335
Leirus perciformis, .....	272
Lepidosteidæ, .....	87
Lepidosteus crassus, .....	89
Lepiopus auritus, .....	293
Lepominae, .....	436, 437
Lepomis, .....	193, 278, 289
auritus, 146, 279, 282, 289, 292,	
293, 299.	
gibbosus, .....	296
palladus, .....	289, 294
pallidus, .....	294, 289, 290, 294
phenax, .....	289, 291
lentiginosus, Botaurus, .....	196

	PAGE.
Leptocephalidæ, .....	118, 121
Leptocephalus, .....	122
conger, .....	122
Lepturus argenteus, .....	247
lepturus, Trichiurus, .....	247
leseurii, Coryphæna, .....	274
Leuciscinæ, .....	126, 134
Leuciscus, .....	127, 134, 148
margarita, .....	134, 135
spirlingulus, .....	145
vandoisulus, .....	134, 135
Leucosomus americanus, .....	138
rhotheus, .....	130, 132
Lichia spinosa, .....	263, 264
Limanda, .....	390, 395
ferruginea, .....	395
limi, Melanura, .....	183
Umbra, .....	183
lineatus, Grammichthys, .....	398
Labrax, .....	307
Mugil, .....	219
Roccus, .....	306, 307
Liostomus obliquus, .....	335
xanthurus, .....	335
littoralis, Carcharias, .....	52
Lobotes emarginatus, .....	317
surinamensis, .....	313, 314
Lobotidæ, .....	236, 313
longipinnis, Peprilus, .....	270
longirostris, Belone, .....	205
Lophiidæ, .....	424
Lophius, .....	425, 426
americanus, .....	426
piscatorius, .....	425
Lophobranchii, .....	201, 230
Lopholatilus, .....	340
chamæleonticeps, .....	340
Lophopsetta, .....	390, 391
maculata, .....	390, 392
Lota, .....	414, 417
maculosa, .....	417, 418
Lotinæ, .....	414
Lucania, .....	184, 188, 197, 198
parva, .....	197, 198
lucinæ, Fundulus, .....	197
Hydrargyra, .....	196
Zygonectes, .....	196
lucias, Micristius, .....	196
Lucioperca vitrea, .....	439
Lucius americanus, .....	177
reticulatus, .....	180
lumpus, Cyclopterus, .....	378, 379
lupus, Anarrhichas, .....	405
Anarrhichas, .....	405
Lutianidæ, .....	236, 315
Lutianus, .....	315
blackfordii, .....	315
griseus, .....	315, 316
Lutjanus blackfordii, .....	317
griseus, .....	317

	PAGE.
Luxilus americanus, .....	138
cornutus, .....	145
lynx, Amiurus, .....	167

## M

macrocephala, Anguilla, .....	121
macrolepidota, Myxostoma, .....	164
macrolepidotum, Moxostoma, .....	163
Myxostoma, .....	164
macrolepidotus, Catostomus, .....	163
Teretribus, .....	164
Teretulus, .....	164
macrorhynchus, Hemirhamphus, .....	210
maculata, Lophopsetta, .....	390, 392
Sophopsetta, .....	391
maculatum, Cybium, .....	245
maculatus, Apodontis, .....	245
Bothus, .....	392
Cynoscion, .....	332
Orbidus, .....	365
Pleuronectes, .....	392
Rhombus, .....	391
Scomberomorus, .....	244, 245
Spheroides, .....	364
maculocinctus, Chætodon, .....	351
maculosa, Lota, .....	417, 418
maculo-striatus, Diodon, .....	367
majalis, Fundulus, .....	184, 185, 188
Hardargyra, .....	188
malleus, Zygæna, .....	66
manatia, Manta, .....	82
Manta, .....	80
birostris, .....	80, 82
manatia, .....	82
margarita, Clinostomus, .....	135
Leuciscus, .....	134, 135
margarotis, Enneacanthus, .....	282
marginata, Rissola, .....	408
marginatum, Ophidion, .....	409
Ophidium, .....	409
marinus, Ælurichthys, .....	166
Ailurichthys, .....	166
Felicthys, .....	165
Galeichthys, .....	166
Petromyzon, .....	48, 49, 50
Sebastes, .....	370
Tylosurus, .....	204, 205
masquingony, Esoc, .....	435
massachusettsensis, Canthorinus, .....	358
Mastacembelidæ, .....	203
mattowaca, Alosa, .....	95
mattowocca, Melatta, .....	95
maxillingua, Exoglossum, .....	154
maximus, Cetorhinus, .....	57, 59
mediocris, Clupea, .....	95, 98
Pomolobus, .....	94, 95
Megalops cepediana, .....	108
Melanogrammus, .....	414, 417
æglefinis, .....	417
æglepinus, .....	417

# 460 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.		PAGE.
Melanura annulata, .....	183	Morone, .....	193, 305, 307
limi, .....	183	americana, .....	129, 308
pygmæa, .....	183	Moroninae, .....	305
Melatta mattowocca, .....	95	Morrhua americana, .....	416
menhaden, Alosa, .....	104	morrhua, Gadus, .....	416
Brevoortia, .....	104	Moxostoma, .....	155, 163
Menidia, .....	198, 213, 214, 215	macrolepidotum, .....	163
beryllina cerea, .....	215	oblongum, .....	163
laciniata, .....	214	mucronatus, Labrax, .....	308
menidia notata, 188, 193, 214,		Murænoides, .....	404
215, 216, 337.		Mugil, .....	218
notata, .....	217	albula, .....	219, 220
menidia notata, Menidia, 188, 193, 214, 215,		cephalus, .....	218, 219
216, 337.		curema, .....	218, 219, 220
Mentiarrhus nebulosus, .....	338	lineatus, .....	219
Menticirrhus, .....	329, 335	petrosus, .....	219
americanus, .....	335	plumievi, .....	219
saxatilis, 214, 335, 336, 337		Mugilidæ, .....	212, 217
Menticirrus alburnus, .....	336	Mullidæ, .....	236, 326
saxatilis, .....	337	Mullus, .....	327
Merganser americanus, .....	398	auratus, .....	327
Merlangus purpureus, .....	415	surmuletus auratus, .....	327
Merlucciidæ, .....	413, 422	multifasciatus, Fundulus, .....	196
Merluccius, .....	422	Murænidæ, .....	118, 123
bilinearis, .....	422	Murænoides mucronatus, .....	404
Merlucius vulgaris, .....	424	Mustelinæ, .....	59
Merone americana, .....	308	Mustelus canis, .....	60
Mesogonistius, .....	277, 284, 285	Myliobatidæ, .....	51, 75
chaetodon, 146, 148, 285, 288		Myliobatis, .....	78, 79
mexicanus, Saurus, .....	118	freminvillii, .....	79
Micristius lucias, .....	197	Myoxocephalus, .....	372, 373
Microgadus, .....	414, 415	æneus, .....	373
tomcod, .....	415	octodecimspinosus, ....	373
tomcodus, .....	416	Myxostoma macrolepidota, .....	164
Microperca punctulata, .....	304	macrolepidotum, .....	164
Micropterinae, .....	436, 438	Myzopsetta ferruginea, .....	395
Micropterus, .....	436, 438		
microstomus, Citharichthys, .....	393		
Etropus, .....	392, 393		
milberti, Carcharhinus, .....	61, 62, 66		
Minnilus amœnus, .....	149		
cornutus, .....	145		
mitchilli, Acanthocottus, .....	373		
Anchovia, .....	109, 110, 112, 214		
Stolephorus, .....	111		
Mobulidæ, .....	51, 80		
Mola, .....	368		
mola, .....	368		
Molacanthus carinatus, .....	369		
mola, Mola, .....	368		
Orthogoriscus, .....	369		
Molidæ, .....	361, 368		
mollis, Achirus, .....	398		
Monacanthidæ, .....	356, 357		
Monacanthus hispidus, .....	358		
monhua, Gadus, .....	416		
monopterygius, Aspidophoroides, ....	377		
mordax, Osmerus, .....	115, 116		
morio, Epinephelus, .....	308		
moris, Epinephelus, .....	308		

## N

nasutus, Argyreus, .....	151
Rhinichthys, .....	151
natalis, Amiurus, .....	169
natalis prosthistiis, Ameiurus, ....	166, 167
Naucrates, .....	250, 251
ductor, .....	251
naucrates, Echeneis, .....	388
nebulosa, Percina, .....	299
nebulosus, Ameiurus, ....	166, 169, 171, 288
Cynoscion, .....	329, 331
Mentiarrhus, .....	338
Nematognathi, .....	83, 117, 164
Neomænis emarginatus, .....	317
niger, Elacate, .....	268
nigrescens, Centropristes, .....	310
nigricans, Catostomus, .....	155, 158
Catostomus Hylomyzon, ....	159
Centropristes, .....	310
Hylomyzon, .....	159
Hypentelium, .....	159
Petromyzon, .....	50



	PAGE.
nigrofasciatus, Fundulus, .....	193
nigrum olmstedii, Boleosoma, .....	299
nitidus, Hybognathus, .....	129
norvegicus, Sebastes, .....	370
notata, Argyrea, .....	217
Menidia, .....	217
notatus, Atherinopsis, .....	217
Hyborhynchus, .....	129
Pimephales, .....	129
Notemigonus chrysoleucus, .....	137
Notropis, .....	127, 138, 149, 279
amoenus, .....	139, 148
analoctanus, .....	138, 142, 196
bifrenatus, .....	138, 139, 140, 146
chalybeus, .....	139, 145, 148, 282, 288
chalybeus abbotti, .....	139, 146, 147, 162
cornutus, .....	139, 143
hudsonius amarus, .....	128, 138 141
progne, .....	138, 140
Noturus gyrinus, .....	172
noveboracensis, Exocoetus, .....	211
Gasterosteus, .....	226
nuchalis, Hybognathus, .....	128, 129
regius, Hybognathus, .....	127, 129
nycticorax nævius, Nycticorax, .....	196
Nycticorax nycticorax nævius, .....	196

## O

obesus, Apomotis, .....	282, 285
Bryttus, .....	284
Enneacanthus, .....	279, 280, 282, 285
Pomotis, .....	284
obliquus, Leiostomus, .....	335
Leiostomus, .....	335
oblongum, Moxostoma, .....	163
oblongus, Erimyzon, .....	163
obscurus, Carcharhinus, .....	61, 62
Carcharias, .....	62
Squalus, .....	62
occidentalis, Conger, .....	123
Pygosteus, .....	225
oceanica, Isognatha, .....	123
ocellaris, Chænopsetta, .....	395
Platessa, .....	395
ocellata, Raja, .....	70, 71
Sciæna, .....	333
ocellatus, Chætodon, .....	350
Gymnothorax, .....	124
Sciænops, .....	60, 333
octodecim-spinosus, Acanthocottus, .....	374
octodecimspinosus, Cottus, .....	374
Myoxocephalus, .....	373
Odontaspis americanus, .....	53
oglinum, Clupanodon, .....	102
Opisthonema, .....	103
olmstedii, Boleosoma, .....	302
Ornithorhynchus, .....	432
tschawytscha, .....	432

	PAGE.
onitis, Tautoga, .....	344, 346
Ophidiidae, .....	398, 407
Ophidium marginatum, .....	409
Opisthonema oglinum, .....	103
Opsanus, .....	411
tau, .....	411
Orbidus maculatus, .....	365
Orthogoriscus mola, .....	369
Orthopristis, .....	318, 319
chrysopterus, .....	319, 320
fulvo-maculatus, .....	320
osmerinus, Hybognathus, .....	128, 129
Osmerus, .....	115, 116
mordax, .....	115, 116
sergenti, .....	116
viridescens, .....	116
osseus, Psalliosotomus, .....	89
Ostraciidae, .....	360
Ostracodermi, .....	202, 360
Otolithinae, .....	329
Otolithus regalis, .....	331
ovicephalus, Sargus, .....	325
ovinus, Cyprinodon, .....	201
oxyrhynchus, Acipenser, .....	86
oxyrinchus, Acipenser, .....	86

## P

Pagrus argyrops, .....	323
Palinurichthys, .....	272
perciformis, .....	272
palladus, Labrus, .....	294
Lepomis, .....	289, 290, 294
pallidus, Lepomis, .....	294
palmipes, Prionotus, .....	382
Paralichthys, .....	390, 393
dentatus, .....	393, 395
Paratractus hippos, .....	255
Pareioplite, .....	202, 369, 379
paru, Sesarinus, .....	269
parva, Lucania, .....	197, 198
parvus, Cyprinodon, .....	198
Pastinaca hastata, .....	77
peckianus, Syngnathus, .....	232
pectinatus, Pristis, .....	69
Pediculati, .....	83, 424
Pelamys, .....	237, 241
alletterata, .....	241
sarda, .....	244
Peprilus longipinnis, .....	270
triacanthus, .....	271
Perca, .....	297, 298
flavescens, .....	146, 288, 298, 299
formosa, .....	318
Percesoces, .....	201, 203, 212
Percidae, .....	236, 297, 439
perciformis, Leiurus, .....	272
Palinurichthys, .....	272
Percina, .....	297, 299
caprodes, .....	299
nebulosa, .....	299

## 462 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.		PAGE.
Percinæ, .....	297	Pomolobus mediocris, .....	94, 95
Percoidæ, .....	235	pseudoharengus, .....	94, 95, 98
Percomorphi, .....	202, 235	pomotis, Acantharchus, .....	278, 280
Percopsis guttatus, .....	274	Acantharcus, .....	280
Petromyzon, .....	48	Ambloplites, .....	280
americanus, .....	50	Centrarchus, .....	280
marinus, .....	48	Pomotis appendix, .....	293
nigricans, .....	50	aureus, .....	297
Petromyzonidæ, .....	48	auritus, .....	293
petrosus, Mugil, .....	219	chætodon, .....	287, 288
phænna, Hybopsis, .....	141	incisor, .....	294
Pharyngognathi, .....	202, 342	obesus, .....	284
phenax, Apomotis, .....	291	Pemoxis, .....	436
Chænobryttus, .....	291	annularis, .....	436, 437
Lepomis, .....	289, 291	hexacanthus, .....	437
phlobotomus, Acanthurus, .....	356	sparoides, .....	436, 437
Pholis, .....	402, 404	Pomoxys sparoides, .....	437
gunnellus, .....	404	Poronotus, .....	269, 270
Phycinæ, .....	414	triacanthus, .....	270, 271
Phycis, .....	414, 418	porosus, Esox, .....	177
chuss, .....	418, 420, 421	præstabilis, Alosa, .....	102
regius, .....	418	Priacanthidæ, .....	236, 311
tenuis, .....	418, 419, 420	Priacanthus altus, .....	313
piliatus, Prionotus, .....	382	Prionotus, .....	380
pilosus, Diodon, .....	366	carolinus, .....	380, 382
Trichodiodon, .....	366	evolans strigatus, .....	380, 382
Pimelodus albidus, .....	167	palmipes, .....	382
Pimephales, .....	126, 128, 129	piliatus, .....	382
notatus, .....	129	strigatus, .....	383
piscatorius, Lophius, .....	425	Pristidæ, .....	51, 68
Pisces, .....	50	Pristis, .....	69
plana, Platessa, .....	396	pectinatus, .....	69
Platessa ocellaris, .....	395	probatocephalus, Archosargus, .....	323, 325
plana, .....	396	procne, Cliola, .....	141
Plectognathi, .....	347	Hybopsis, .....	140
Pleuronectidæ, .....	389	Notropis, .....	138, 140
Pleuronectes americanus, .....	396	prosthistus, Amiurus, .....	168, 169
maculatus, .....	392	Psallisostomatidæ, .....	87, 88
plumieri, Hæmulon, .....	318	Psallisostomus, .....	89
plumievi, Mugil, .....	219	osseus, .....	89
pneumatophorus, Scomber, .....	240	pseudoharengus, Clupea, .....	97
Pœcilichthys cœmieu, .....	304	Pomolobus, .....	94, 95, 98
erochrous, .....	304	Pseudopleuronectes, .....	390, 396
fusiforme, .....	304	americanus, .....	396
Pœciliidæ, .....	174, 183	Pseudopriacanthus, .....	312
Pellachius, .....	413, 414	altus, .....	312
virens, .....	414, 415	Pterophryne, .....	426
Pogonias, .....	329, 338	gibba, .....	426, 427
chromis, .....	339	histrio, .....	426, 427
cromis, .....	338, 339	punctata, Bairdiella, .....	333
fasciatus, .....	339	Lamna, .....	55
Pomacanthinæ, .....	350	punctatus, Bryttus, .....	282
Pomacanthus, .....	350, 353	Decapterus, .....	254
arcuatus, .....	353, 354	Ichthælurus, .....	431
Pomacentridæ, .....	287	Ictalurus, .....	431
Pomatomidæ, .....	235, 264	punctulata, Hippocampus, .....	233, 234
Pomatomus, .....	265	Microperca, .....	304
saltatrix, .....	265, 266	pungitius, Pygosteus, .....	224
Pomolobus, .....	92, 93, 94, 193	purpureus, Merlangus, .....	415
cyanonoton, .....	94, 98	pygmæa, Melanura, .....	183

	PAGE.
pygmæa, Umbra, .....	180, 183, 193, 282
Pygosteus, .....	224
dekayi, .....	225
occidentalis, .....	225
pungitius, .....	224

## Q

quadracus, Apeltes, .....	227, 228
Gasterosteus, .....	228
quadriloba, Raia, .....	80
Rhinoptera, .....	80

## R

Rachycentridæ, .....	235, 267
Rachycentron, .....	267
canadus, .....	267
radiata, Raja, .....	73
Raia americana, .....	73
chantenay, .....	73, 75
diaphanes, .....	73
eglantiera, .....	73
lævis, .....	75
quadriloba, .....	80
Raja, .....	70
eglanteria, .....	70, 72, 73
erinacea, .....	70
erinaceus, .....	71
lævis, .....	70, 73
ocellata, .....	70, 71
radiata, .....	73
say, .....	78
Rajidæ, .....	51, 69
raphidoma, Tylosurus, .....	204, 205
regalis, Cynoscion, .....	331, 332, 329
Otolithus, .....	331
Scomberomorus, .....	244, 246
Umbrina, .....	338
regius, Hybognathus, .....	128, 129
Phycis, .....	418
remora, Echeineis, .....	389
Remora, .....	387, 388
Remora remora, .....	388
Reniceps tiburo, .....	65
reticulatus, Esox, .....	175, 177, 179
Lucius, .....	180
Rhinichthys, .....	127, 149
atronasus, .....	149, 151, 153, 302
cataractæ, .....	149, 150
nasutus, .....	151
Rhinoptera, .....	78, 79
bonasus, .....	79
quadriloba, .....	80
Rhomboganoidea, .....	83, 87
rhomboides, Lagodon, .....	323
Trachynotus, .....	263
Rhombus maculatus, .....	391
rhotheus, Leucosomus, .....	130, 132
Semotilus, .....	132

## PAGE.

Rissola, .....	408
marginata, .....	408
roberti, Hemirhamphus, .....	209
Roccus, .....	305, 306, 440
americanus, .....	308
chrysops, .....	440
lineatus, .....	306, 307
rostra, Anguilla, .....	121
rostrata, Anguilla, .....	121
rubricauda, Ichthelis, .....	293
rupestris, Ambloplites, .....	437, 438

## S

sadina, Clupea, .....	93
Etrumeus, .....	93
salar, Salmo, .....	433, 434
salar sebago, Salmo, .....	433, 434
Salmo, .....	432, 433
fario, .....	433, 434
fontinalis, .....	114
salar, .....	433, 434
salar sebago, .....	433, 434
salmoides, Micropterus, .....	438, 439
Salmonidæ, .....	90, 112, 113, 114, 432
Salmonoidea, .....	90
saltator, Temnodon, .....	266
saltatrix, Pomatomus, .....	265, 266
Salvelinus, .....	113, 432, 434
alpinus, .....	434, 435
fontinalis, .....	113
sapidissima, Alosa, .....	99
Clupea, .....	101
Sarda, .....	237, 242
sarda, .....	242, 244
sarda, Pelamys, .....	244
Sarda, .....	242, 244
Sargassum, .....	427
Sargus ovicephalus, .....	325
Saurus mexicanus, .....	118
saurus, Elops, .....	91
Scombresox, .....	207
saxatilis, Menticirrhus, .....	214, 335, 336, 337
Menticirrhus, .....	337
say, Dasybatus, .....	76, 77
Raja, .....	78
sayanus, Aphrododerus, .....	276
Aphredoderus, .....	275, 276
Aphrodederus, .....	276
sayii, Trygon, .....	77
Scaridæ, .....	342, 346
Schilbeodes, .....	164, 171
gyrinus, .....	171, 172, 173
insignis, .....	171, 172, 173
schœpfi, Chilomycterus, .....	367
schœpfi, Chilomycterus, .....	366
schœpfii, Alutera, .....	359
Sciæna ocellata, .....	333
Sciænidae, .....	236, 328

# 464 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.		PAGE.
Sciæninæ, .....	329	Sparisoma, .....	346, 347
Sciænops, .....	329, 333	sparoides, Pomoxis, .....	436, 437
ocellatus, .....	60, 333	Pomoxys, .....	437
Sclerodermi, .....	202, 356	Spheroides, .....	362, 364
Scoliodon, .....	59, 63	maculatus, .....	364
terræ-novæ, .....	63	Sphyræna, .....	221
Scomber, .....	237	barracuda, .....	221
colias, .....	237, 239, 240	borealis, .....	221, 222, 223
dekayi, .....	245	Sphyrænidæ, .....	212, 220
grex, .....	240	Sphyrna zygaena, .....	66
pneumatophorus, .....	240	spinosa, Lichia, .....	263
scombrus, .....	237, 238	spinosa, Trachynotus, .....	263
vernalis, .....	238	spirlingulus, Leuciscus, .....	145
Scomberomorus, .....	237, 244	Squalidæ, .....	51, 66
maculatus, .....	244, 245	Squalius funduloides, .....	135
regalis, .....	244, 246	Squalus, .....	67
Scombresocidæ, .....	203, 206	acanthias, .....	67, 68, 416
Scombresox, .....	207	americanus, .....	68
saurus, .....	207	cæruleus, .....	63
scutellatus, .....	207	elephas, .....	59
Scombridæ, .....	207, 235, 236, 250	obscurus, .....	62
Scombroidæ, .....	235	Squamipennes, .....	202, 347
scombrus, Scomber, .....	237, 238	Stenotomus, .....	321
Scorpenidæ, .....	369, 370	arenosus, .....	323
scutellatus, Scombresox, .....	207	argyrops, .....	323
Sebastes, .....	370	chrysops, .....	321, 322
marinus, .....	370	Stephanolepis, .....	358
norvegicus, .....	371	hispidus, .....	358
segnifer, Canthorinus, .....	358	Stilbe americana, .....	138
Selene, .....	251, 260	Stizostedion, .....	439
gallus, .....	261	vitreum, .....	439
vomere, .....	260, 261	Stizostedium vitreum, .....	439
Semotilus, .....	127, 130	Stolephorus browni, .....	110
atromaculatus, .....	130, 132, 134	eurystole, .....	109
bullaris, .....	130, 132	mitchilli, .....	111
corporalis, .....	132, 134	storieriana, Cliola, .....	142
rhotheus, .....	132	striatus, Chætodon, .....	350, 351
sergenti, Osmerus, .....	116	Centropristes, .....	308, 310, 335
Seriola, .....	250, 251	strigatus, Prionotus, .....	383
dumerili lalandi, .....	253	Stromateidæ, .....	235, 269, 271
lalandi, .....	251, 253	Stromateus triacanthus, .....	271
zonata, .....	251, 253	sturio, Acipenser, .....	85, 86
Seriolinæ, .....	250	sturio oxyrhynchus, Acipenser, .....	86
Serranidæ, .....	236, 304, 318, 440	subarcuatus, Cestracion, .....	66
Serraninæ, .....	305	sucetta, Erismyzon, .....	163
serratus, Solenostomus, .....	230	sucetta oblongus, Erismyzon, .....	146, 159, 279, 282.
Seserinus, .....	269	surinamensis, Lobotes, .....	313, 314
paru, .....	269	surmuletus auratus, Mullus, .....	327
setapinnis, Vomer, .....	259	swampina, Hydrargyra, .....	196
setipinnis, Vomer, .....	259	Synentognathi, .....	201, 203
signifer, Chatessus, .....	103	Syngnathidæ, .....	230
Siluridæ, .....	164, 431	Syngnathus, .....	231
simulans, Enneacanthus, .....	282	fuscus, .....	231
Siphostoma fuscum, .....	232	peckianus, .....	232
Soleidæ, .....	389, 396	viridescens, .....	232
Solenostomus serratus, .....	230	Synodontidæ, .....	90, 116
tabacarius, .....	230	Synodus, .....	117
Sophius americanus, .....	426	fetens, .....	117, 118
Sophopsetta maculata, .....	391		
Sparidæ, .....	236, 320, 348		

	PAGE.		PAGE.
<b>T</b>		<i>Trygon hastata</i> , .....	77
<i>tabaccaria</i> , <i>Fistularia</i> , .....	229	<i>sayii</i> , .....	77
<i>tabaccaria</i> , <i>Fistularia</i> , .....	230	<i>tschawytscha</i> , <i>Oncorhynchus</i> , .....	432
<i>tabacarius</i> , <i>Solenostomus</i> , .....	230	<i>turgidus</i> , <i>Gastrophysus</i> , .....	365
<i>Tachysurinae</i> , .....	164	<i>Tetraodon</i> , .....	365
<i>tau</i> , <i>Batrachns</i> , .....	412	<i>Tetrodon</i> , .....	365
<i>Batrachus</i> , .....	412	<i>Tylosurus</i> , .....	204
<i>Opsanus</i> , .....	411	<i>gladius</i> , .....	206
<i>Tautoga</i> , .....	343, 344	<i>marinus</i> , .....	204, 205
<i>americana</i> , .....	346	<i>raphidoma</i> , .....	204, 205
<i>onitis</i> , .....	344, 346	<i>tyrannus</i> , <i>Alosa</i> , .....	98
<i>tautoga</i> , <i>Labrus</i> , .....	346	<i>Brevoortia</i> , .....	103, 104
<i>Tautogolabrus</i> , .....	343		
<i>adpersus</i> , ....	335, 343, 344	<b>U</b>	
<i>Tectospondyli</i> , .....	51	<i>Umbra</i> , .....	179, 180, 276
<i>Teleostei</i> , .....	83	<i>limi</i> , .....	183
<i>Temnodon saltator</i> , .....	266	<i>pygmæa</i> , ....	180, 183, 193, 282
<i>tenuirostris</i> , <i>Anguilla</i> , .....	121	<i>Umbriæ</i> , .....	174, 180
<i>tenuis</i> , <i>Phycis</i> , .....	418, 419, 420	<i>Umbrina alburnus</i> , .....	338
<i>teres</i> , <i>Alosa</i> , .....	93	<i>regalis</i> , .....	338
<i>Catostomus</i> , .....	158	<i>umbrosus</i> , <i>Esox</i> , .....	177
<i>Etrumeus</i> , .....	93	<i>unifasciatus</i> , <i>Hyporhamphus</i> , .....	209
<i>Teretulus macrolepidotus</i> , .....	164	<i>Unio complanatus</i> , .....	128
<i>terræ-novæ</i> , <i>Scoliodon</i> , .....	63	<i>Upsilonphorus anoplos</i> , .....	400
<i>Tetraodon turgidus</i> , .....	365	<i>guttatus</i> , .....	402
<i>Tetrasomus camelinus</i> , .....	360	<i>Uranidea</i> , .....	372
<i>Tetrodon turgidus</i> , .....	365	<i>gracilis viscosa</i> , .....	372
<i>Tetrodontiæ</i> , .....	361	<i>Uranoscopidæ</i> , .....	398
<i>Tholichthys</i> , .....	350	<i>Uranoscopus guttatus</i> , .....	402
<i>thrissa</i> , <i>Clupanodon</i> , .....	103	<i>Urolophus</i> , .....	75, 76
<i>Thunnis</i> , .....	237, 241	<i>jamaicensis</i> , .....	76
<i>thynnus</i> , .....	241, 242	<i>torpedinus</i> , .....	76
<i>thynnus</i> , <i>Thunnus</i> , .....	241, 242		
<i>tiburo</i> , <i>Cestracion</i> , .....	64, 65	<b>V</b>	
<i>Reniceps</i> , .....	65	<i>vagrans laciniata</i> , <i>Kirtlandia</i> , .....	213
<i>Zygæna</i> , .....	65	<i>vandoisulus</i> , <i>Leuciscus</i> , .....	134, 135
<i>tigrinus</i> , <i>Galeus</i> , .....	61	<i>vampyrus</i> , <i>Cephalopterus</i> , .....	82
<i>temcod</i> , <i>Microgadus</i> , .....	415	<i>Ceraptera</i> , .....	82
<i>temcodus</i> , <i>Microgadus</i> , .....	416	<i>variegatus</i> , <i>Antennarius</i> , .....	427
<i>terpedinus</i> , <i>Urolophus</i> , .....	76	<i>Batrachoides</i> , .....	42
<i>Trachinotinae</i> , .....	251	<i>Batrachus</i> , .....	412
<i>Trachinotus</i> , .....	56, 214, 251, 262	<i>Cyprinodon</i> , .....	198, 201
<i>carolinus</i> , ...	214, 262, 263, 337	<i>velox</i> , <i>Euleptorhamphus</i> , .....	209
<i>falcatus</i> , .....	262	<i>vermiculatus</i> , <i>Esox</i> , .....	177
<i>Trachynotus carolinus</i> , .....	264	<i>vernalis</i> , <i>Scomber</i> , .....	238
<i>rhomboides</i> , .....	263	<i>virens</i> , <i>Pollachius</i> , .....	414, 415
<i>spinosus</i> , .....	263	<i>virescens</i> , <i>Butorides</i> , .....	196
<i>triacanthus</i> , <i>Peprilus</i> , .....	271	<i>virginianus</i> , <i>Acanthocottus</i> , .....	374
<i>Poronotus</i> , .....	270, 271	<i>virginicus</i> , <i>Anisotremus</i> , .....	319
<i>Stromateus</i> , .....	271	<i>viridescens</i> , <i>Osmerus</i> , .....	116
<i>Trichiuridæ</i> , .....	235, 246	<i>Syngnathus</i> , .....	232
<i>Trichiurus</i> , .....	247	<i>vitrea</i> , <i>Lucioperca</i> , .....	439
<i>lepturus</i> , .....	247	<i>vitreum</i> , <i>Stizostedion</i> , .....	439
<i>Trichodiodon</i> , .....	365, 366	<i>Stizostedium</i> , .....	439
<i>pilosus</i> , .....	366	<i>vittata</i> , <i>Engraulis</i> , .....	110
<i>Triglidæ</i> , .....	379	<i>volitans</i> , <i>Cephalacanthus</i> , .....	384, 385
<i>trigonus</i> , <i>Lactophrys</i> , .....	360	<i>Dactylopterus</i> , .....	384
<i>triourus</i> , <i>Bodianus</i> , .....	314		
<i>truncata</i> , <i>Belone</i> , .....	205		

# 466 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.		PAGE.
Vomer, .....	251, 259	<b>Z</b>	
setapinnis, .....	259	zebra, Fundulus, .....	193
setipinnis, .....	259	Zoarces, .....	406
vomer, Selene, .....	260, 261	anguillaris, .....	406, 407
vulgaris, Anguilla, .....	121	ciliatus, .....	407
Merlucius, .....	424	Zoarcidæ, .....	398, 405
vulpes, Alopias, .....	53	zonata, Seriola, .....	251, 253
<b>X</b>		zenatus, Zonichthys, .....	253
xanthurus, Leiostomus, .....	334, 335	Zonichthys zonatus, .....	253
Liostomus, .....	335	zygæna, Cestracion, .....	64, 65
Xiphias, .....	248	Sphyrna, .....	66
gladius, .....	248, 249	Zygæna malleus, .....	66
Xiphiidæ, .....	235, 248	tiburo, .....	65
<b>Y</b>		Zygonectes, .....	184, 196
y-græcum, Astroscopus, .....	399	luciæ, .....	196

## Index to Common Names.

### A

	PAGE.
Abbott's minnow, .....	146
Albacore, .....	241
Alewife, .....	95
Alewives, .....	94
Alligator fishes, .....	376
All mouth, .....	425
Amber fishes, .....	251
American club fish, .....	103
soles, .....	397
Anchovies, .....	108
archovies, Silvery, .....	108
Anchovy, .....	109
angel, Black, .....	353
Angel fish, .....	348, 354
angels, Black, .....	353
Angler, .....	425
Anglers, .....	424, 425
Apple core, .....	241
Atlantic salmon, .....	433
Attractive minnow, .....	148

### B

back, Brass, .....	99
bait, White, .....	213
Balaos, .....	207
Balloon fish, .....	366
Banded drum, .....	338
pickerel, .....	175
seriola, .....	251
sun fish, .....	146, 285
Banker, .....	103
Barb, .....	336
Barn door skate, .....	73
barracuda, Northern, .....	222
Barracudas, .....	220, 221
Barred minnow, .....	193
Basking sharks, .....	57
bass, Black, .....	308, 438
Calico, .....	437
Channel, .....	333
Grass, .....	437
Large mouth black, .....	438
Large mouthed, .....	438
Oswego, .....	438
Rock, .....	437
Sea, .....	304, 308
Silver, .....	440

### PAGE.

bass, Small mouthed black, .....	438
Strawberry, .....	437
Striped, .....	306, 440
White, .....	440
Bass sun fish, .....	278
beaks, Half, .....	208
Bellows fish, .....	425
Bengal, .....	343
Bergall, .....	343
Big cat fish, .....	166
drum, .....	338
porgy, .....	321
spotted skate, .....	71
Bill fish, .....	204, 207, 231
Black angel, .....	353
angels, .....	353
baes, .....	308, 438
cat fish, .....	169
drum, .....	338
eared sun fish, .....	292
fish, .....	308, 329, 344
fishes, .....	344
grunt, .....	313
nosed dace, .....	149
perch, .....	313
rudder fish, .....	272
rudder fishes, .....	272
sea bass, .....	308
sucker, .....	158
black fish, Smooth, .....	344
Blanquillos, .....	339
Blennies, .....	402
blennies, Shell, .....	403
Blenny, .....	403
Blob, .....	372
Blobs, .....	372
blower, Mud, .....	417
Blue fish, .....	265
fishes, .....	264, 265
gill sun fish, .....	294
lined minnow, .....	141
spotted sun fish, .....	280
sun fish, .....	294
Blunt head, .....	188, 193
nosed minnow, .....	129
nosed shiner, .....	259
nosed sturgeon, .....	86
Bob tailed skate, .....	72
Bone eater, .....	242
jack, .....	242

# 468 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.
Bonito, .....	242
Bonitos, .....	242
Bonnet headed shark, .....	65
Bony fish, .....	103
Boston mackerel, .....	238
Brass back, .....	99
Breams, .....	135
Bridled minnow, .....	139
Brier ray, .....	72
Brook trout, .....	113, 434
Brown trout, .....	434
Bull head, .....	169, 373
bull head, Common, .....	169
headed eel, .....	119
Bunker, .....	103
Butter fish, .....	263, 404
fishes, .....	270
Butterfly fishes, .....	349, 350
Burbots, .....	417
Burr fishes, .....	366

## C

Calico bass, .....	437
Cape May goody, .....	334
caranx, Yellow, .....	254
Southern, .....	254
Carp, .....	430
like fishes, .....	125
carp, Leather, .....	430
Mirror, .....	430
Carps, .....	125, 429, 430
carps, Crucian, .....	430
Casabes, .....	261
Cero, .....	246
cat, Channel, .....	165
Salt water, .....	165
Sea, .....	165
Stone, .....	171, 173
Cat fish, .....	166, 167, 169
cat fish, Big, .....	166
Black, .....	169
Lake, .....	431
Little, .....	171
Marine, .....	166
Mud, .....	169, 171, 173
Oceanic, .....	165
Poison, .....	171, 173
River, .....	166
Sea, .....	165
Spotted, .....	431
Stone, .....	169
White, .....	166
Yellow, .....	169
Cat fishes, .....	164, 431
cat fishes, Gaff topsail, .....	165
Catalufas, .....	311
catalufas, Rough, .....	312
cats, Channel, .....	431
Chaetodon, .....	283

	PAGE.
Chain pickerel, .....	177
Channel bass, .....	333
cat, .....	165
cats, .....	431
Charrs, .....	113, 434
choice, Sailor's, .....	323
choker, Hog, .....	397
Chub, .....	130, 132, 344
mackerel, .....	239
sucker, .....	159
suckers, .....	159
clip, Cover, .....	397
club fish, American, .....	103
Coachman, .....	310
fishes, .....	310
Cod, .....	416
fish, .....	416
fishes, .....	413, 416
fish shark, .....	67
shark, .....	67
sharks, .....	416
cod, Tom, .....	415
cods, Tom, .....	415
Common bull head, .....	169
eastern pickerel, .....	177
herring, .....	93
pampano, .....	263
puffer, .....	364
sculpin, .....	373
sun fish, .....	294, 295
Conger, .....	122
eel, .....	122
eel pout, .....	406
eels, .....	121, 122
Conner, .....	343
core, Apple, .....	241
Cornet fishes, .....	228
Cover clip, .....	397
Cow fish, .....	79, 80
Cow nosed ray, .....	79
nosed rays, .....	79
Crab eater, .....	267
Crappie, .....	437
Crappies, .....	436
Crest gilled fishes, .....	230
Crevallé, .....	254
Crevallés, .....	254
Crimson darter, .....	302
Croakers, .....	328
Crucian carps, .....	430
Cucumber fish, .....	366
Cunners, .....	343
Cutlass fish, .....	247
fishes, .....	246
Cut lips minnow, .....	154
minnows, .....	154
Cusk, .....	421
eels, .....	407
Cusks, .....	421
cusks, Sand, .....	408



	PAGE.
cybium, Spotted, .....	244
Cyprininae, .....	429

**D**

dabs, Mud, .....	395
Dace, .....	134, 135, 150, 151
dace, Black nosed, .....	149, 150, 151
Rosy, .....	134
Striped, .....	151
Damsel fishes, .....	287
Darter, .....	299, 302
darter, Crimson, .....	302
Fusiform, .....	302
Sand, .....	299
Tessellated, .....	299
darters, Little, .....	302
Deceptive sun fish, .....	289
Devil fish, .....	76, 80
fishes, .....	80
devils, Sea, .....	80
Ditch pike, .....	175
Doctor fishes, .....	356
Dog fish, .....	60, 188, 193
dog fish, Spiny, .....	67
Dog shark, .....	60
Dog sharks, .....	60, 66, 416
dog sharks, Spiny, .....	67
Dog sherk, .....	60
Dollar fish, .....	260, 270
Dolphin, .....	273
Dolphins, .....	272, 273
dory, Hair finned, .....	260
Hair finned silver, .....	260
Spinous, .....	262
Double bearded flying fish, .....	211
Drum fish, .....	338
drum, Banded, .....	338
Big, .....	338
Black, .....	338
Gray, .....	338
Red, .....	333
drums, Red, .....	333
Sea, .....	338
Dusky shark, .....	61

**E**

Eagle rays, .....	78, 79
Eared sunfishes, .....	289
eater, Bone, .....	242
Crab, .....	267
Man, .....	61
Spawn, .....	141
Eel, .....	119
pout, .....	406
pouts, .....	405, 406
eel, Bull headed, .....	119

	PAGE.
eel, Conger, .....	122
Sand, .....	408
Sea, .....	122
eel pout, Conger, .....	406
Eels, .....	118, 119
eels, Cusk, .....	407
Conger, .....	121, 122
Electric star gazers, .....	399
eye, Goggle, .....	437
Red, .....	437
eyes, Nine, .....	48

**F**

Fall fishes, .....	130
herring, .....	94
mackerel, .....	239
Fat heads, .....	129
Fiatolas, .....	269
File fish, .....	357, 358
fishes, .....	357
file fish, Orange, .....	359
Thread, .....	358
fin, Red, .....	43
Silver, .....	142
Fine scaled suckers, .....	155
fins, Scaly, .....	347
fish, Angel, .....	348, 354
Balloon, .....	366
Bellows, .....	425
Bill, .....	204, 207, 231
Black, .....	308, 344
Blue, .....	265, 329
Bony, .....	103
Butter, .....	56, 263, 404
Cat, .....	166, 167, 169
Cod, .....	416
Cow, .....	79, 80
Cucumber, .....	366
Cutlass, .....	247
Dog, .....	60, 188, 193
Dollar, .....	260, 270
Drum, .....	338
Devil, .....	76, 80
File, .....	357, 358
Flat, .....	396
Flying, .....	211, 380, 382
Fool, .....	358
Frost, .....	115, 117, 415
Gar, .....	89
Globe, .....	368
Goat, .....	327
Gold, .....	430
Goose, .....	425
Harvest, .....	270
Head, .....	368, 425
Hog, .....	299
Horse, .....	233, 234
Killi, .....	185, 198
Killie, .....	188, 193

# 470 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.		PAGE.
fish, King, .....	335, 336	fishes, Harvest, .....	269
Lizard, .....	117	Head, .....	363
Lump, .....	378	Isospondylous, .....	90
May, .....	185	Jugular, .....	398
Moon, .....	259	Killi, .....	183, 184
Mouse, .....	427	King, .....	335
Mud, .....	180	Labroid, .....	342
Oyster, .....	411	Leather, .....	358
Pig, .....	380, 382	Lizard, .....	116, 117
Pilot, .....	251	Lump, .....	378
Pipe, .....	229, 231	Mail cheeked, .....	369
Rabbit, .....	362	Moon, .....	260
Red, .....	333	Mouse, .....	426
Rock, .....	306	Needle, .....	203
Rudder, .....	269	Parrot, .....	346
Saw, .....	69	Pediculate, .....	424
Silver, .....	213	Perch like, .....	212, 235
Silver gar, .....	204	Pig, .....	319
Spotted balloon, .....	366	Pike like, .....	174
Spotted cat, .....	431	Pilot, .....	251
Squirrel, .....	318	Pipe, .....	230, 231
Sun, .....	282, 359, 368	Plough, .....	259
Suck, .....	387	Porcupine, .....	365
Swell, .....	364	Pork, .....	319
Sword, .....	204, 248	Rabbit, .....	362
Tile, .....	340	Rain water, .....	197
Toad, .....	364, 411	Ribbon, .....	247
Trigger, .....	357	Rock, .....	370
Trumpet, .....	229	Rose, .....	370
Trunk, .....	360	Rudder, .....	271
Unicorn, .....	359	Saw, .....	68, 69
Weak, .....	69, 329	Shark like, .....	50
Wind, .....	135	Sergeant, .....	267
Wolf, .....	405	Spade, .....	347, 348
Fishes, .....	50	Spiny rayed, .....	201
fishes, Alligator, .....	376	Sun, .....	276, 295, 436
Amber, .....	251	Surgeon, .....	355
Black, .....	344	Sword, .....	248
Blue, .....	264, 265	Synentognathous, .....	203
Burr, .....	366	Thread, .....	259
Butter, .....	270	Tile, .....	340
Butterfly, .....	349, 350	Toad, .....	411
Carp like, .....	125	Trigger, .....	356, 357
Cat, .....	164, 431	True, .....	82
Coachman, .....	310	Trumpet, .....	229
Cod, .....	413, 416	Trunk, .....	360
Cornet, .....	228	Weak, .....	329
Crest gilled, .....	230	Wolf, .....	404, 405
Cutlass, .....	246	Wrasse, .....	342
Damsel, .....	287	Flat fish, .....	396
Devil, .....	80	flat fish, New York, .....	396
Doctor, .....	356	Flat fishes, .....	389
Fall, .....	130	Flounder, .....	393, 396
File, .....	357	flounder, Long toothed, .....	393
Flat, .....	389	Oblong, .....	393
Flying, .....	210, 211	Sand, .....	390
Frog, .....	426	Spotted, .....	390
Hairy, .....	366	Summer, .....	393
Half gilled, .....	223	Winter, .....	396
Hard skinned, .....	356	Flounders, .....	389

	PAGE.
flounders, Little, .....	392
Winter, .....	396
Fluke, .....	393, 395
Flying fish, .....	211, 380, 382
fishes, .....	210, 211
gurnards, .....	383
robin, .....	384
flyng fish, Double bearded, .....	211
Single bearded, .....	211
Fool fish, .....	358
Frog fishes, .....	426
Frost fish, .....	115, 117, 415
Fusiform darter, .....	302
<b>G</b>	
Gaff topsail cat fishes, .....	165
Gall, .....	343
Gar, .....	89, 204, 206
fish, .....	89
pike, .....	89
pikes, .....	87, 88, 89
gar, Green, .....	204
Silvery, .....	204
gazer, Star, .....	372, 399, 401
gazers, Star, .....	398
Gizzard shad, .....	105
Globe fish, .....	368
Goat fish, .....	327
Gobies, .....	385
gobies, Naked, .....	386
Goby, .....	386
goly. Variegated, .....	386
Goggle-eye, .....	437
eyed perch, .....	437
Gold fish, .....	430
thread shiner, .....	135
Goodies, .....	69, 334
Goody, .....	334
goody, Cape May, .....	334
Goose fish, .....	425
Grass bass, .....	437
Gray drum, .....	338
Great sculpins, .....	373
tunnies, .....	241
tunny, .....	241
Green gar, .....	204
pipe fish, .....	231
Grouper, .....	308
grouper, Red, .....	308
Groupers, .....	308
Grunt, .....	318
grunt, Black, .....	313
Grunters, .....	317
Grunts, .....	318
Gudgeon, .....	127, 128, 135, 141
Gudgeons, .....	127
Gunnell, .....	404
Gunnells, .....	404
gurnard, Spinous, .....	380

	PAGE.
Gurnards, .....	379
gurnards, Flying, .....	383

**H**

Haddock, .....	417
Haddocks, .....	417
Hair finned dory, .....	260
silver dory, .....	260
Hairy fishes, .....	366
Hair tail, .....	246
Hake, .....	336, 418, 419, 422
Hakes, .....	418, 422
Half beaks, .....	208
half beaks, Ribbon, .....	209
Half gilled fishes, .....	223
Halibut, .....	393
Hammer head, .....	65
head sharks, .....	64
heap shark, .....	65
Hard head, .....	103
skinned fishes, .....	356
Harvest fish, .....	270
fishes, .....	269
pike, .....	204
Head fish, .....	368, 425
fishes, .....	368
head, Blunt, .....	188, 193
Bull, .....	169, 373
Hammer, .....	65
Hard, .....	103
Horny, .....	153
Sheep's, .....	323
heads, Fat, .....	129
Horny, .....	153
Sheep's, .....	323
Hedgehog ray, .....	70
Herring, .....	94, 95
herring, Common, .....	93
Fall, .....	94
River, .....	95
Round, .....	93
Thread, .....	102
Herrings, .....	92, 93
herrings, Round, .....	93
Thread, .....	102
Hickory shad, .....	94, 105
Hog choker, .....	397
fish, .....	299
Horned pout, .....	166, 169, 431
Horny head, .....	153
heads, .....	153
Horse fish, .....	233, 234
mackerel, .....	265
horse, Sea, .....	233
horses, Red, .....	163
Sea, .....	233
Hound eared sun fish, .....	292

# 472 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.		PAGE.
<b>I</b>		Log perches, .....	299
Indian remora, .....	387	Lump fish, .....	378
Isabillas, .....	354	fishes, .....	378
Isospondylous fishes, .....	90	suckers, .....	377
<b>J</b>		<b>M</b>	
jack, Bone, .....	242	Mackerel, .....	238, 239, 265
Skip, .....	242, 262	porbeagle, .....	54
Jenny lind, .....	253	shark, .....	56
Jugular fishes, .....	398	sharks, .....	54, 56
jugular fishes, Spineless, .....	413	scads, .....	254
Jurel, .....	258	mackerel, Boston, .....	238
<b>K</b>		Chub, .....	239
Killi fish, .....	185, 198	Fall, .....	239
fishes, .....	183, 184	Horse, .....	265
Killie fish, .....	188, 193	Snap, .....	265
killie fish, Little, .....	197	Snapping, .....	265
Killy, .....	188, 193	Spanish, .....	244
King fish, .....	335, 336	Thimble eye, .....	239
fishes, .....	335	Yellow, .....	254, 256
<b>L</b>		Mackerels, .....	236, 237
Labroid fishes, .....	342	mackerels, Spanish, .....	244
Lake cat fish, .....	431	Mademoiselles, .....	332
Lamper eel, .....	48	Mad toms, .....	171
Lamprey, .....	48	Mailed cheek fishes, .....	369
lamprey, Green, .....	48	maker, Shoe, .....	259
River, .....	48	Mamoose, .....	85, 86
Sea, .....	48	Mamouche, .....	85, 86
Lampreys, .....	48	Man eater, .....	61
lampreys, True, .....	48	eating shark, .....	61
lance, Sand, .....	410	Many spined stickleback, .....	224
Land locked salmon, .....	434	Marine cat fish, .....	166
Large mouthed bass, .....	438	May fish, .....	185
black bass, .....	438	Menhaden, .....	56, 103
launces, Sand, .....	409	Menhadens, .....	103
Leather carp, .....	430	Miller's thumb, .....	169
fishes, .....	358	Minnie, .....	145
Leopard shark, .....	61	Minnow, .....	146, 185, 188, 193
light, Window, .....	390	minnow, Abbott's, .....	146
lind, Jenny, .....	253	Attractive, .....	148
Ling, .....	417, 419, 420	Barred, .....	193
ling, Thimble eyed, .....	419, 420	Blue lined, .....	141
Little cat fish, .....	171	Blunt nosed, .....	120
darters, .....	302	Bridled, .....	139
flounders, .....	392	Cut lips, .....	154
killie fish, .....	197	Mud, .....	180
tunnies, .....	241	Pursy, .....	198
Lizard fish, .....	117	River, .....	183
fishes, .....	116, 117	Silvery, .....	14, 127
Long eared sun fish, .....	146, 292	minnows, Cut lips, .....	154
nosed dace, .....	150, 151	Mud, .....	180
toothed flounder, .....	393	Pursy, .....	198
		Top, .....	196
		Minny, .....	143
		Mirror carp, .....	430
		Mojarras, .....	325
		Mojarritas, .....	325

	PAGE.
Moon fish, .....	259
fishes, .....	260
Moose, .....	85
Mossbanker, .....	103
Mossbunkers, .....	103
Mouse fish, .....	427
fishes, .....	426
mouth, All, .....	425
Satchel, .....	425
Morays, .....	123
merays, Tropical, .....	124
Mud blower, .....	417
cat fish, .....	169, 171, 173
dabs, .....	395
fish, .....	180
minnow, .....	180
minnows, .....	180
perch, .....	275
pike, .....	175
shad, .....	105
sucker, .....	158
sun fish, .....	278, 437
sun fishes, .....	278
Mullet, .....	146, 159, 218, 219
mullet, Red, .....	327
Striped, .....	218
White, .....	219
Mullets, .....	217, 218
mullets, Sur, .....	326
Mummichog, .....	188
Muskallunge, .....	435

## N

Naked gobies, .....	386
ned, Yellow, .....	146, 298
Needle fishes, .....	203
New York flat fish, .....	396
sole, .....	397
stickleback, .....	225
Nibbler, .....	343
Nine eyes, .....	42
spined sticklebacks, .....	224
Northern barracuda, .....	222

## O

Oblong flounder, .....	393
Ocean sun fish, .....	368
sun fishes, .....	368
trout, .....	103
Oceanic cat fish, .....	165
Orange file fish, .....	359
Oswego bass, .....	438
Oyster fish, .....	411

## P

Pampano, .....	263
pampano, Common, .....	263
Round, .....	262

	PAGE.
Pampanos, .....	249, 262
panes, Window, .....	390
Parrot fishes, .....	346
Pediculate fishes, .....	424
Peerch, .....	298, 307
Perch, .....	298, 307
perch, Black, .....	313
Goggle eyed, .....	437
Mud, .....	275
Pike, .....	439
Pirate, .....	275
Red sea, .....	370
River, .....	298
Sand, .....	299
Silver, .....	332
Triple tailed, .....	313
White, .....	307
Yellow, .....	298, 307
Perches, .....	298, 439
perches, Log, .....	299
Pirate, .....	274, 275
Perch-like fishes, .....	212, 235
Pickrel, .....	175, 177
pickrel, Banded, .....	175
Chain, .....	177
Common eastern, .....	177
Pigeon sting ray, .....	76
Pig fish, .....	380, 382
pig fish, Rock, .....	380
Sand, .....	382
Pig fishes, .....	319
Pike, .....	175, 177
perch, .....	439
like fishes, .....	174
shiner, .....	134
pike, Ditch, .....	175
Gar, .....	89
Harvest, .....	204
Mud, .....	175
Sea, .....	204
Short billed, .....	175
Silver, .....	115
Wall eyed, .....	439
Pikes, .....	174, 175, 435
pikes, Gar, .....	87, 88, 89
Wall eyed, .....	439
Pilot fish, .....	251
fishes, .....	251
pilot, Shark's, .....	251
Pipe fish, .....	229, 231
fishes, .....	230, 231
pipe fish, Green, .....	231
Pirate, .....	275
perch, .....	275
perches, .....	274, 275
Plough fishes, .....	259
poachers, Sea, .....	277
Poison cat fish, .....	171, 173
Pollock, .....	414
Pollocks, .....	414

# 474 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.
porbeagle, Mackerel, .....	50
Porbeagles, .....	54
Porcupine fishes, .....	365
Pork fishes, .....	319
Porgee, .....	321
porgee, Rhomboidal, .....	323
Sand, .....	321
Porgies, .....	320
Porgy, .....	321, 334
porgy, Big, .....	321
Possum ray, .....	72
possum, Sea, .....	72
pounder, Ten, .....	91
pounders, Ten, .....	91
pout, Eel, .....	406
Horned, .....	166, 169, 431
pouts, Eel, .....	405, 406
Puffer, .....	362, 364
puffer, Common, .....	364
Puffers, .....	361
Pursy minnow, .....	198
minnows, .....	198

## Q

Quinnat salmon, .....	432
-----------------------	-----

## R

Rabbit fish, .....	362
fishes, .....	362
Rain water fishes, .....	197
raven, Sea, .....	375
ravens, Sea, .....	375
ray, Brier, .....	72
Cow nosed, .....	79
Hedge hog, .....	70
Possum, .....	72
Sting, .....	76
rays, Cow nosed, .....	79
Eagle, .....	78, 79
Sting, .....	72, 75, 76
Red bellied sun fish, .....	292
drum, .....	333
drums, .....	333
eye, .....	437
fin, .....	43
fish, .....	333
grouper, .....	308
horses, .....	163
mullet, .....	327
sea perch, .....	370
snapper, .....	317
red mouth, Speckled, .....	319
Remora, .....	388
remora, Indian, .....	387
White tailed, .....	387
Remoras, .....	56, 386, 388
Requiem sharks, .....	61
Rhomboidal porgee, .....	323

	PAGE-
Ribbon fish, .....	247
half beaks, .....	209
River cat fish, .....	166
herring, .....	95
minnow, .....	188
perch, .....	298
sucker, .....	155, 163
sun fish, .....	292
Roach, .....	135, 146
robin, Flying, .....	384
Round, .....	254
Sea, .....	380, 382
Rock, .....	306
bass, .....	437
fish, .....	306
fishes, .....	370
pig fish, .....	380
sun fish, .....	282
Rose fishes, .....	370
Rosy dace, .....	134
Rough catalufas, .....	312
scaled silversides, .....	213
Round herring, .....	93
herrings, .....	93
pampano, .....	262
robin, .....	254
sting rays, .....	76
Rudder fish, .....	269
rudder fish, Black, .....	272
Rudder fishes, .....	271
rudder fishes, Black, .....	272

## S

Salt water cat, .....	165
Saibling, .....	434
Sailor's choice, .....	323
Salmon, .....	432, 433
salmon, Atlantic, .....	433
Land locked, .....	434
Quinnat, .....	432
Salmon, .....	112
Sand cusks, .....	408
darter, .....	299
eel, .....	408
flounder, .....	390
lance, .....	410
launces, .....	409
perch, .....	299
pig fish, .....	382
porgee, .....	321
shark, .....	52
sharks, .....	51, 52
smelt, .....	216
Santiago, .....	61
Satchel mouth, .....	425
Sauries, .....	206, 207
Saw fish, .....	69
fishes, .....	68, 69
Say's sting ray, .....	77

	PAGE.		PAGE.
Scad, .....	254	sharks, Sand, .....	51, 52
scads, Mackerel, .....	254	Sharp nosed, .....	63
Scaly fins, .....	347	Thresher, .....	53
Sculpin, .....	373	Tiger, .....	61
sculpin, Common, .....	373	Typical, .....	59
Sculpins, .....	371	Shark's pilot, .....	251
sculpins, Great, .....	373	Sharp nosed shark, .....	63
Scup, .....	321	sharks, .....	63
Scups, .....	321	Sheep's head, .....	323
Sea bass, .....	304, 308	heads, .....	323
cat, .....	165	Shell blennies, .....	403
cat fish, .....	165	sherk, Dog, .....	60
devils, .....	80	Shiner, .....	135, 137, 142, 143
drums, .....	338	shiner, Blunt nosed, .....	259
eel, .....	122	Gold thread, .....	135
horse, .....	233	Pike, .....	134
horses, .....	233	Smelt, .....	141
pike, .....	204	Shiners, .....	138
poachers, .....	377	Shoe maker, .....	259
possum, .....	72	Short billed pike, .....	175
raven, .....	375	nosed sturgeon, .....	86
ravens, .....	375	Shovel nose shark, .....	52, 65
robin, .....	380, 382	Sier, .....	246
tog, .....	344	Siering, .....	246
sea bass, Black, .....	308	Silver bass, .....	440
Searer, .....	246	fin, .....	142
Sergeant fishes, .....	267	fish, .....	213
seriola, Banded, .....	251	gar, .....	204
Shad, .....	99	gar fish, .....	204
shad, Gizzard, .....	105	perch, .....	332
Hickory, .....	94, 105	pike, .....	115
Mud, .....	105	Silverside, .....	216
Young, .....	135	Silversides, .....	212, 213, 215, 216
Shadine, .....	94, 103	silversides, Rough scaled, .....	213
Shark, .....	52, 61	Silvery anchovies, .....	108
Suckers, .....	387	gar, .....	204
shark, Bonnet headed, .....	65	minnow, .....	14, 127
Cod, .....	67	Single bearded flying fish, .....	211
Cod fish, .....	67	Skate, .....	72, 73
Dusky, .....	60, 61	skate, Barn door, .....	73
Hammer heap, .....	65	Big spotted, .....	71
Leopard, .....	61	Bob tailed, .....	72
Mackerel, .....	56	Skates, .....	69, 70
Man eating, .....	61	Skip jack, .....	242, 265
Sand, .....	52	Small blue shark, .....	62
Sharp nosed, .....	63	mouthed black bass, .....	438
Shovel nose, .....	52, 65	Smelt, .....	115
Small blue, .....	62	shiner, .....	141
Spotted, .....	61	smelt, Sand, .....	216
Thorn back, .....	67	Smelts, .....	114, 115
Thresher, .....	53	Smooth black fish, .....	344
White, .....	62	Snap mackerel, .....	265
Shark like fishes, .....	50	Snapper, .....	265
sharks, Basking, .....	57	snapper, Red, .....	317
Cod, .....	416	Snappers, .....	315
Dog, .....	60, 66, 416	Snapping mackerel, .....	265
Fox, .....	53	Snippick, .....	204
Hammer head, .....	64	Sole, .....	390, 397
Mackerel, .....	54, 56	sole, New York, .....	397
Requeim, .....	61	Soles, .....	396

# 476 REPORT OF NEW JERSEY STATE MUSEUM.

	PAGE.		PAGE.
soles, American, .....	397	Sucker, .....	155
Southern caranx, .....	254	sucker, Black, .....	158
Soury, .....	117	Chub, .....	159
Spade fishes, .....	347, 348	Mud, .....	158
Spaniard, .....	244	River, .....	155, 163
Spanish mackerel, .....	244	White, .....	155
mackerels, .....	244	Suckers, .....	154
Spawn eater, .....	141	suckers, Chub, .....	159
Speckled red mouth, .....	319	Fine scaled, .....	155
Sperlin, .....	110	Lump, .....	377
Spineless jugular fishes, .....	413	Shark, .....	387
Spinous dory, .....	262	Summer flounder, .....	393
gurnard, .....	380	Sun fish, .....	282, 359, 368
Spiny dog fish, .....	67	sun fish, Banded, .....	146, 285
dog sharks, .....	67	Bass, .....	278
rayed fishes, .....	201	Black eared, .....	292
Splaice, .....	393	Blue, .....	294
Spot, .....	334	Blue gill, .....	294
Spotted balloon fish, .....	366	Blue spotted, .....	280
cat fish, .....	431	Common, .....	294, 295
cybium, .....	244	Deceptive, .....	289
fin sun fish, .....	282	Hound eared, .....	292
finned sun fish, .....	280	Long eared, .....	146, 292
flounder, .....	390	Mud, .....	278, 437
shark, .....	61	Ocean, .....	368
sun fish, .....	146, 280	Red bellied, .....	292
sun fishes, .....	280	River, .....	292
turbot, .....	390	Rock, .....	282
weak fish, .....	331	Spotted, .....	146, 280
Squeateague, .....	329	Spotted fin, .....	282
Squirrel fish, .....	318	Spotted finned, .....	280
Star gazer, .....	372, 399, 401	Sun fishes, .....	276, 295, 436
gazers, .....	398	sun fishes, Eared, .....	289
star gazers, Electric, .....	399	Mud, .....	278
Stickleback, .....	224, 225, 227	Ocean, .....	368
stickleback, Many spined, .....	224	Spotted, .....	280
New York, .....	225	Sunny, .....	295
Two spined, .....	225	Surgeon, .....	356
Sticklebacks, .....	223	fishes, .....	355
sticklebacks, Nine spined, .....	224	Sur mullets, .....	326
Ten spined, .....	224	Swell fish, .....	364
Three spined, .....	227	Sword fish, .....	204, 248
Stingaree, .....	76, 79	fishes, .....	248
Sting ray, .....	76	Synentognathous fishes, .....	203
sting ray, Pigeon, .....	76		
Say's, .....	77		
Whip, .....	77		
Sting rays, .....	72, 75, 76		
sting rays, Round, .....	76		
Stone cat, .....	171, 173		
cat fish, .....	169		
Strawberry bass, .....	437		
Striped bass, .....	306, 440		
dace, .....	151		
mullet, .....	218		
Sturgeon, .....	85		
sturgeon, Blunt nosed, .....	86		
Short nosed, .....	86		
Sturgeons, .....	84, 85		
Suck fish, .....	387		

## T

tail, Hair, .....	246
Triple, .....	313
Yellow, .....	261
Tailor, .....	265
tails, Triple, .....	313
Tarpons, .....	90
Tautog, .....	344
Ten pounder, .....	91
pounders, .....	91
spined stickleback, .....	224
Tessellated darter, .....	299
darters, .....	299



	PAGE.
Thimble eyed ling, .....	419, 420
eye mackerel, .....	239
Thorn back shark, .....	67
Thread file fish, .....	358
fishes, .....	259
herring, .....	102
herrings, .....	102
Three spined sticklebacks, .....	227
Thresher shark, .....	53
sharks, .....	53
thumb, Miller's, .....	169
Tiger sharks, .....	61
Tile fish, .....	340
fishes, .....	340
Toad fish, .....	364, 411
fishes, .....	411
tog, Sea, .....	344
Tom cod, .....	415
cods, .....	415
toms, Mad, .....	171
Top minnows, .....	196
Trigger fish, .....	357
fishes, .....	356, 357
Triple tail, .....	313
tailed perch, .....	313
tails, .....	313
Tropical morays, .....	124
Trout, .....	113
trout, Brook, .....	113, 434
Brown, .....	434
Ocean, .....	103
Von Behr, .....	434
True fishes, .....	82
Trumpet fish, .....	229
fishes, .....	229
Trunk fish, .....	360
fishes, .....	360
tunnies, Great, .....	241
Little, .....	241
Tunny, .....	241
tunny, Great, .....	241
turbot, Spotted, .....	390
Two spined stickleback, .....	225
Typical sharks, .....	59

## U

Unicorn fish, .....	359
---------------------	-----

## V

Variegated goby, .....	386
Viejas, .....	346
Von Behr trout, .....	434

## W

Wall eyed pike, .....	439
pikes, .....	439
Weak fish, .....	69, 329
fishes, .....	329
weak fish, Spotted, .....	331
Whip sting ray, .....	77
White bait, .....	213
bass, .....	440
cat fish, .....	166
mullet, .....	219
perch, .....	307
shark, .....	62
sucker, .....	155
tailed remora, .....	387
Wind fish, .....	135
Window light, .....	390
panes, .....	390
Winter flounder, .....	396
flounders, .....	396
Wolf fish, .....	405
fishes, .....	404, 405
Wrasse fishes, .....	342

## Y

Yellow caranx, .....	254
cat fish, .....	169
mackerel, .....	254, 256
ned, .....	146, 298
perch, .....	298, 307
tail, .....	261
Young shad, .....	135



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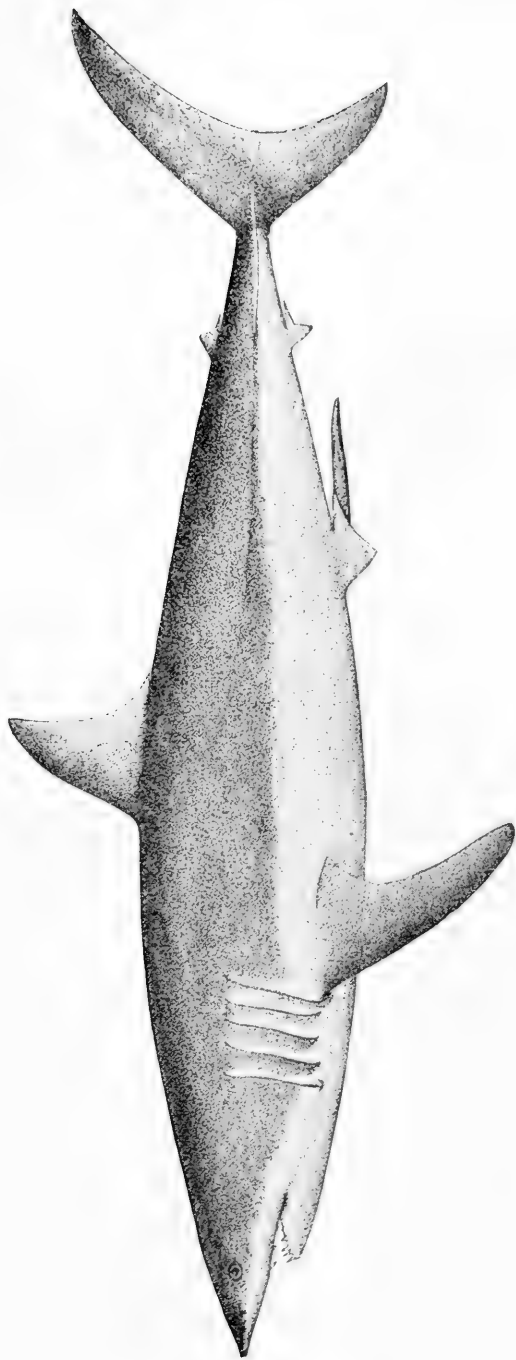
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PLATES.

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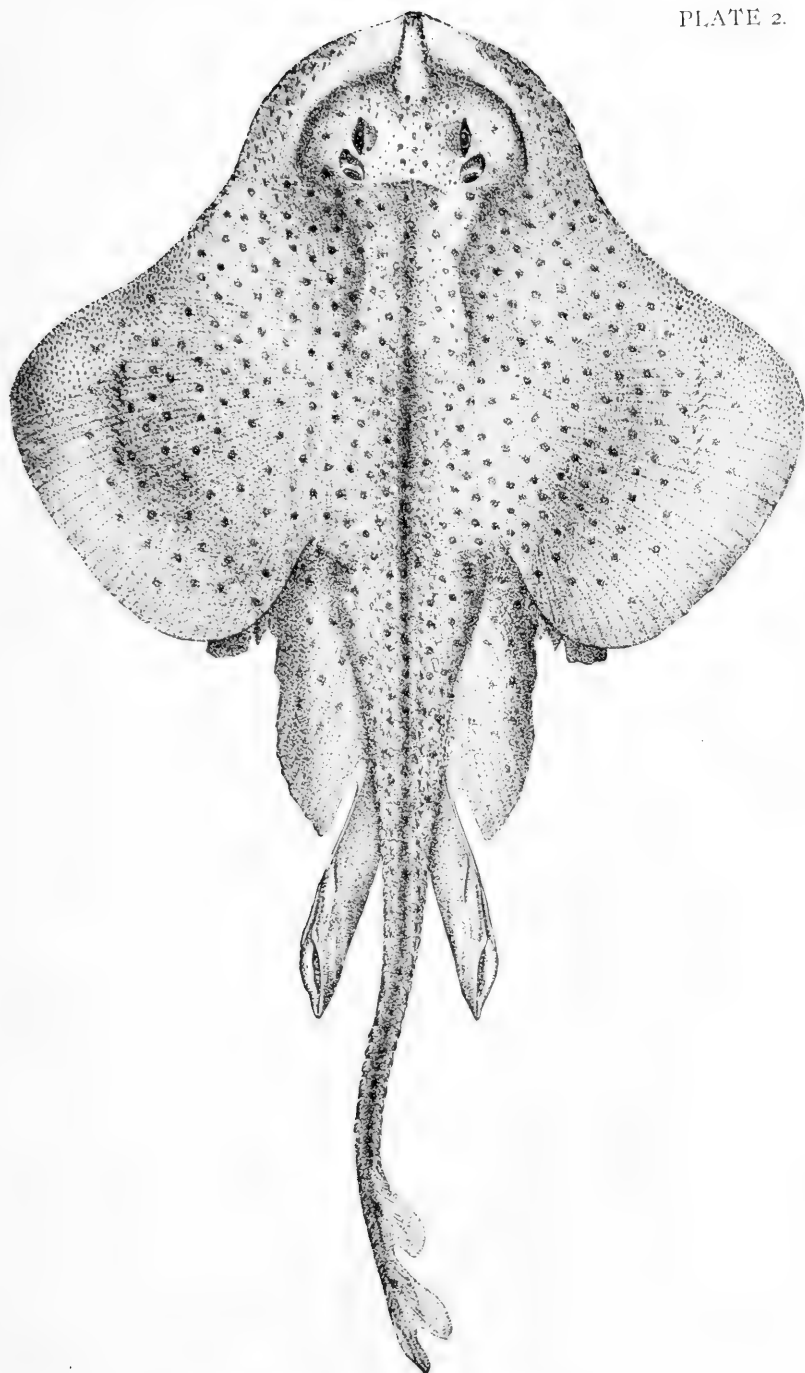
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MACKEREL PORBEAGLE. *Isurus dekayi* (Gill).

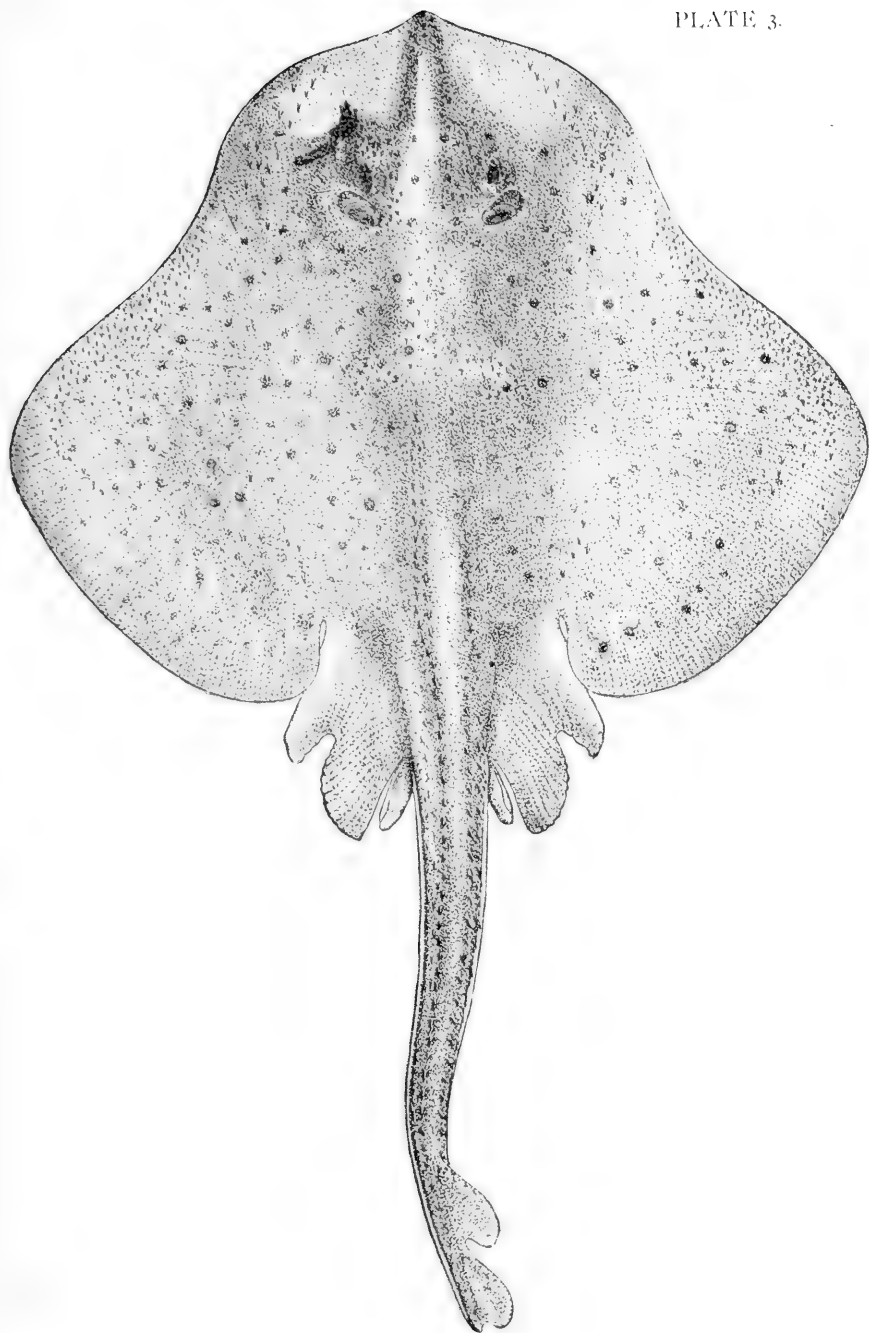




HEDGE HOG RAY. *Raja erinacea* Mitchill.







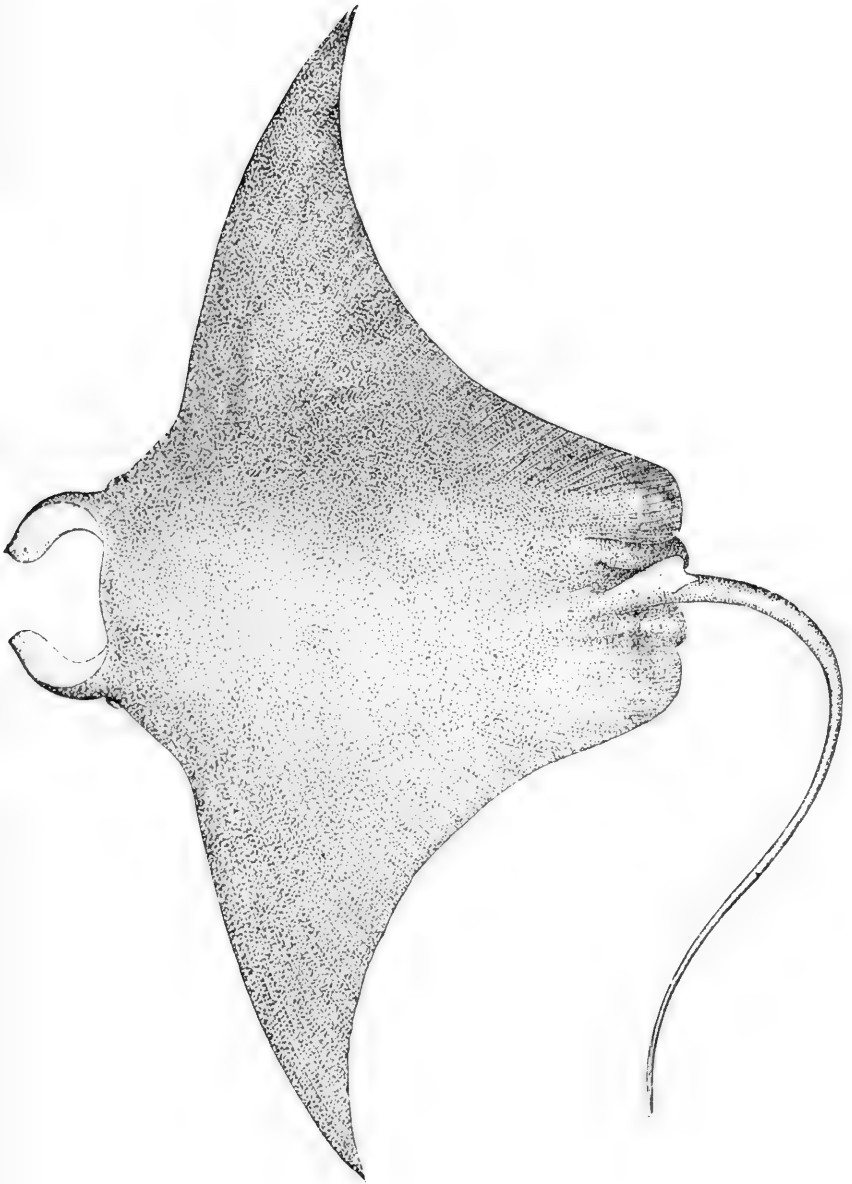
BIG SPOTTED SKATE. *Raja ocellata* (Mitchill).





BARN DOOR SKATE. *Raja lævis* Mitchill.





DEVIL FISH. *Manta birostris* (Walbaum).

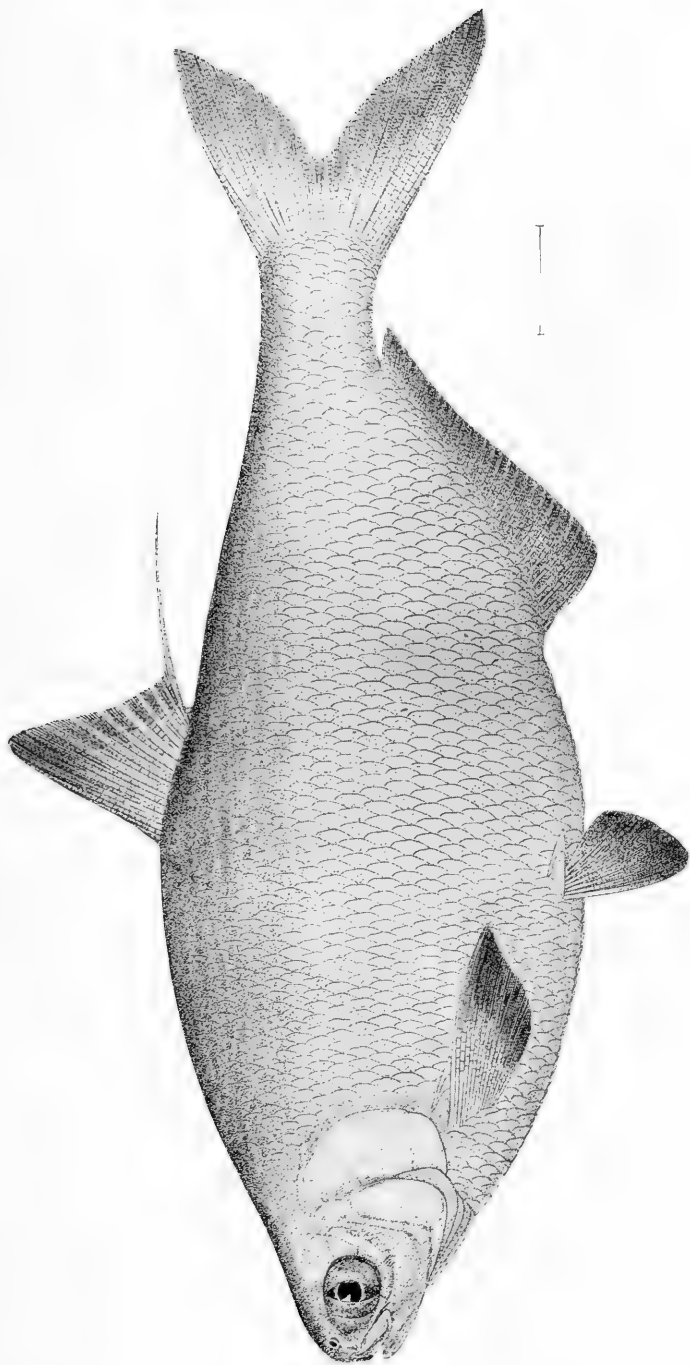




MENHADEN. *Brevortia tyrannus* (Latrobe).

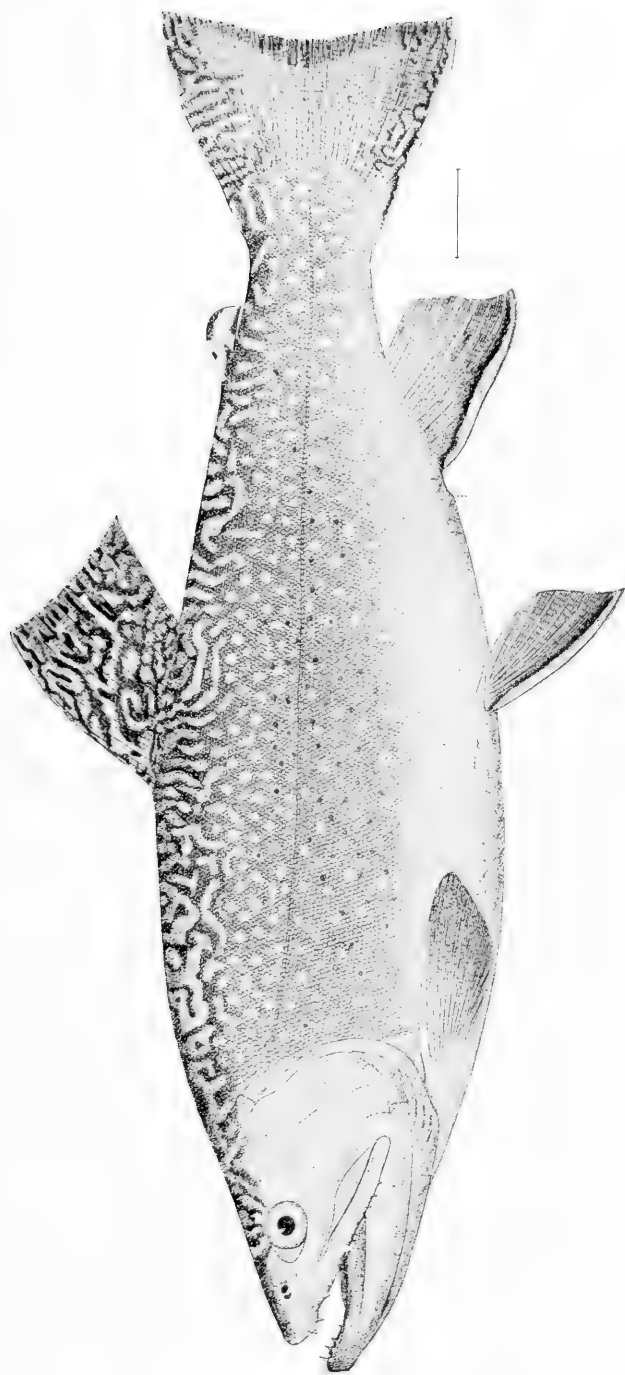






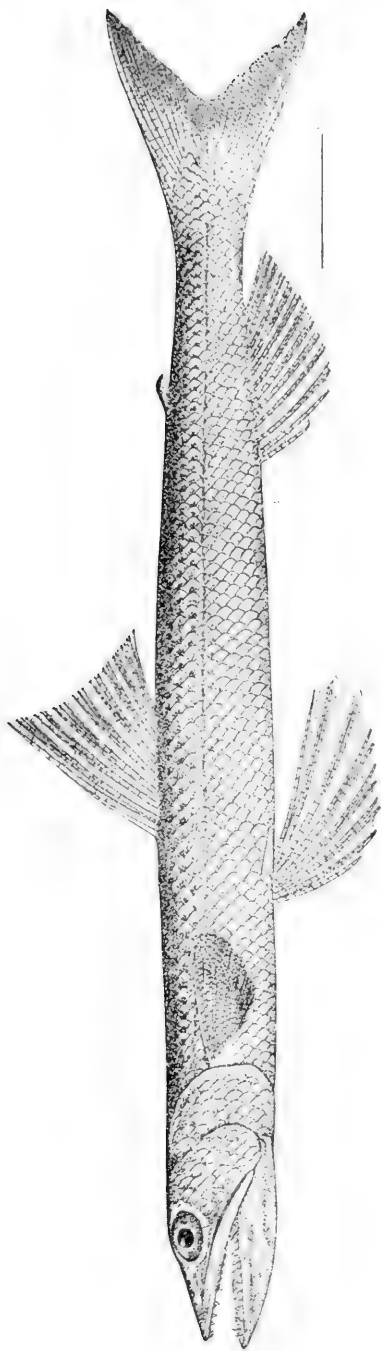
GIZZARD SHAD. *Dorosoma cepedianum* (Le Sueur).





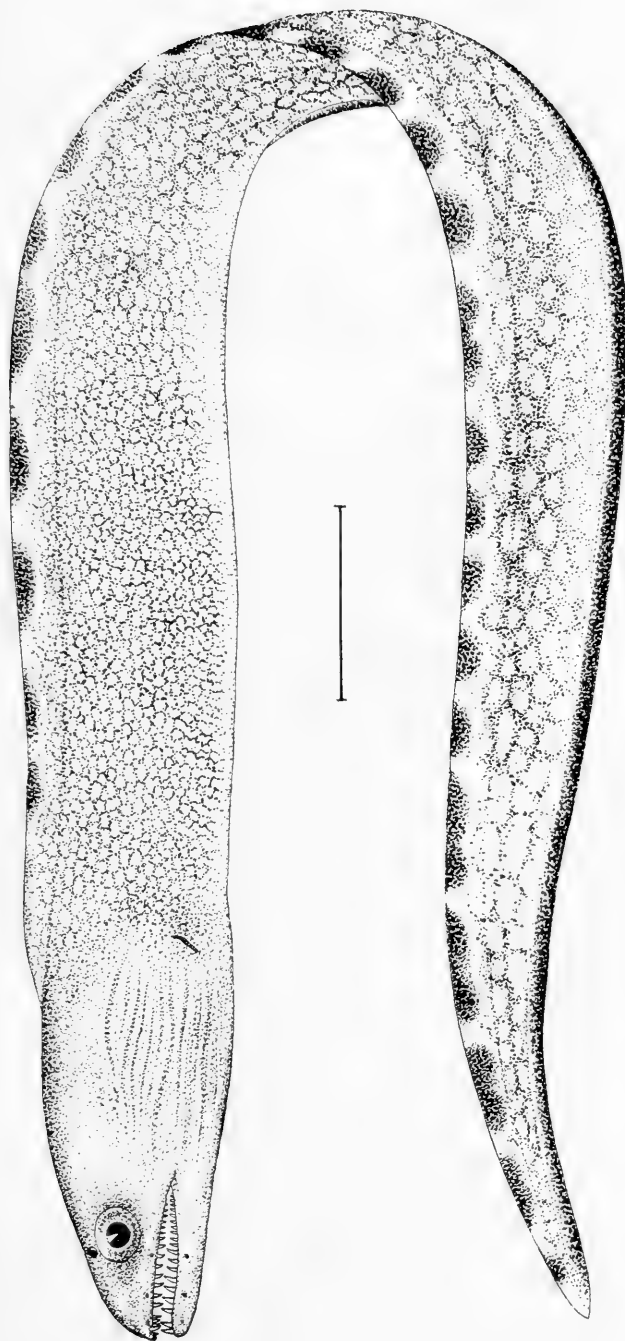
BROOK TROUT. *Salvelinus fontinalis* (Mitchill).





LIZARD FISH. *Synodus foetens* (Linnaeus).

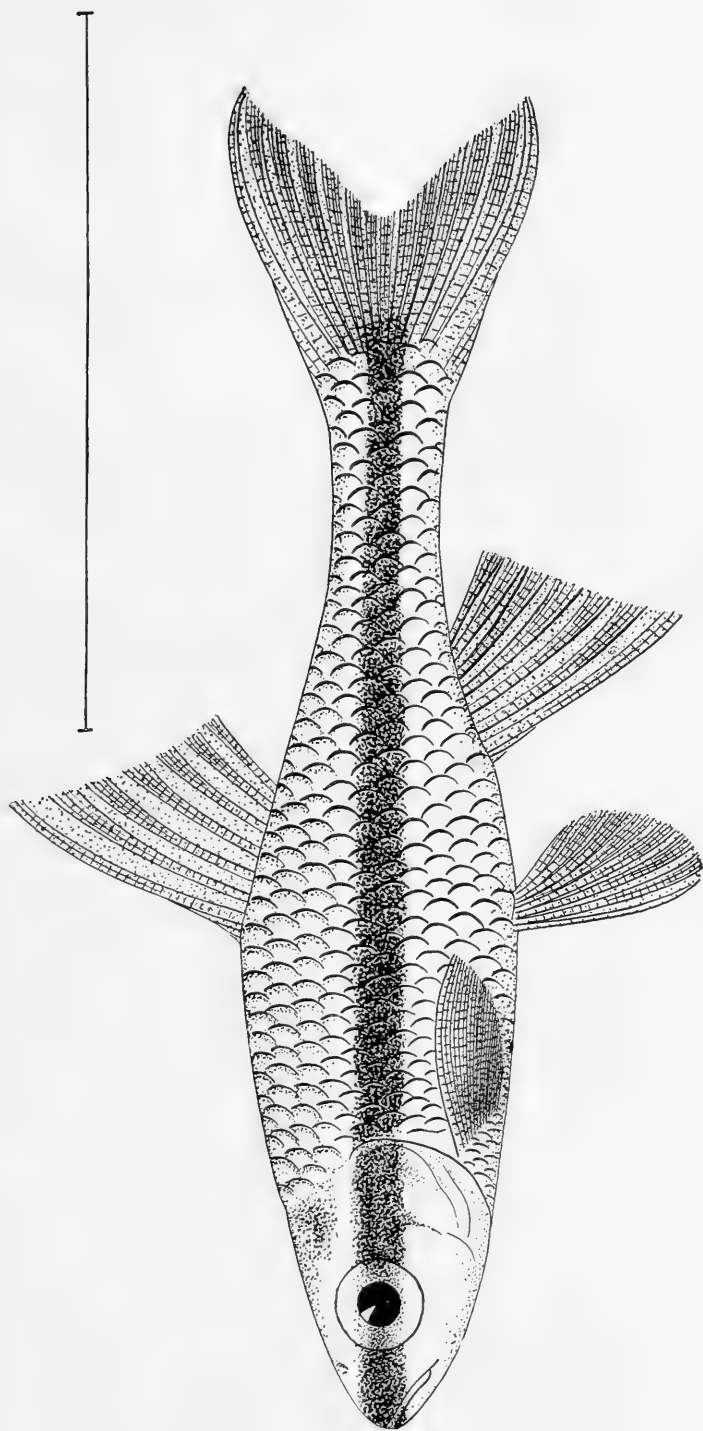




SPOTTED MORAY. *Gymnothorax ocellatus* (Agassiz).

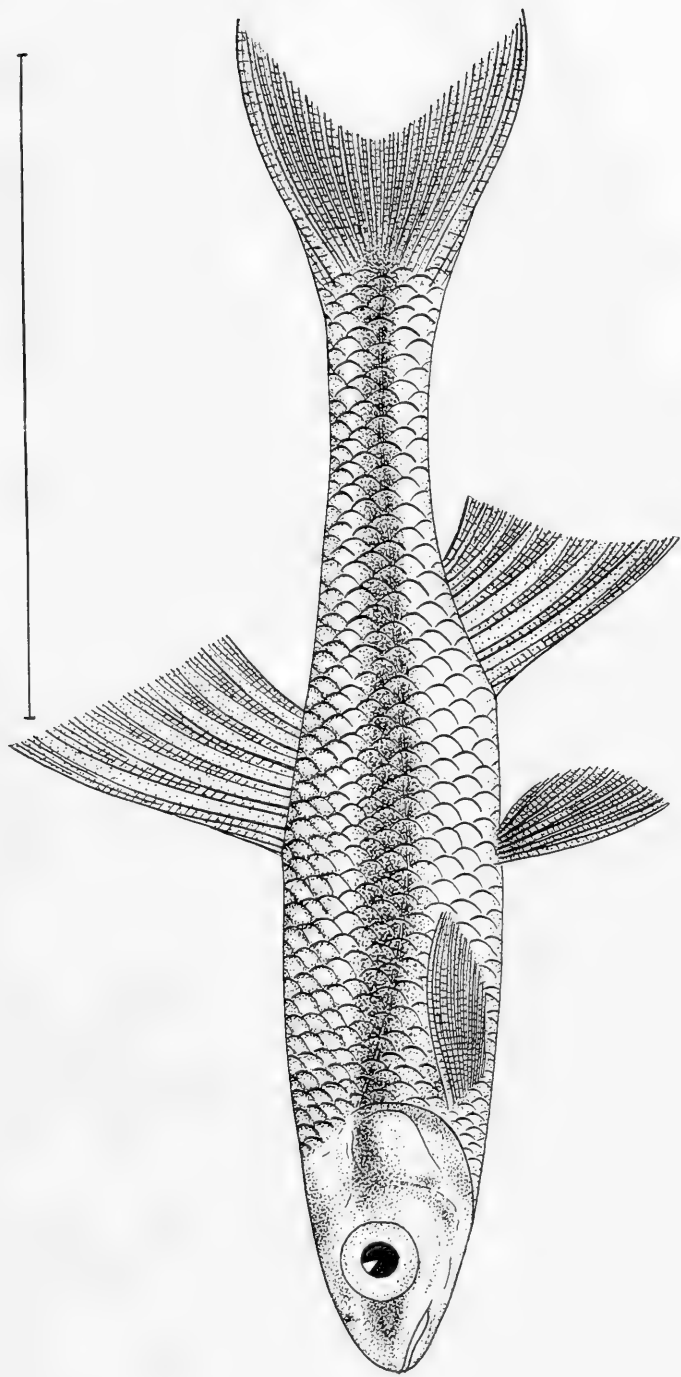






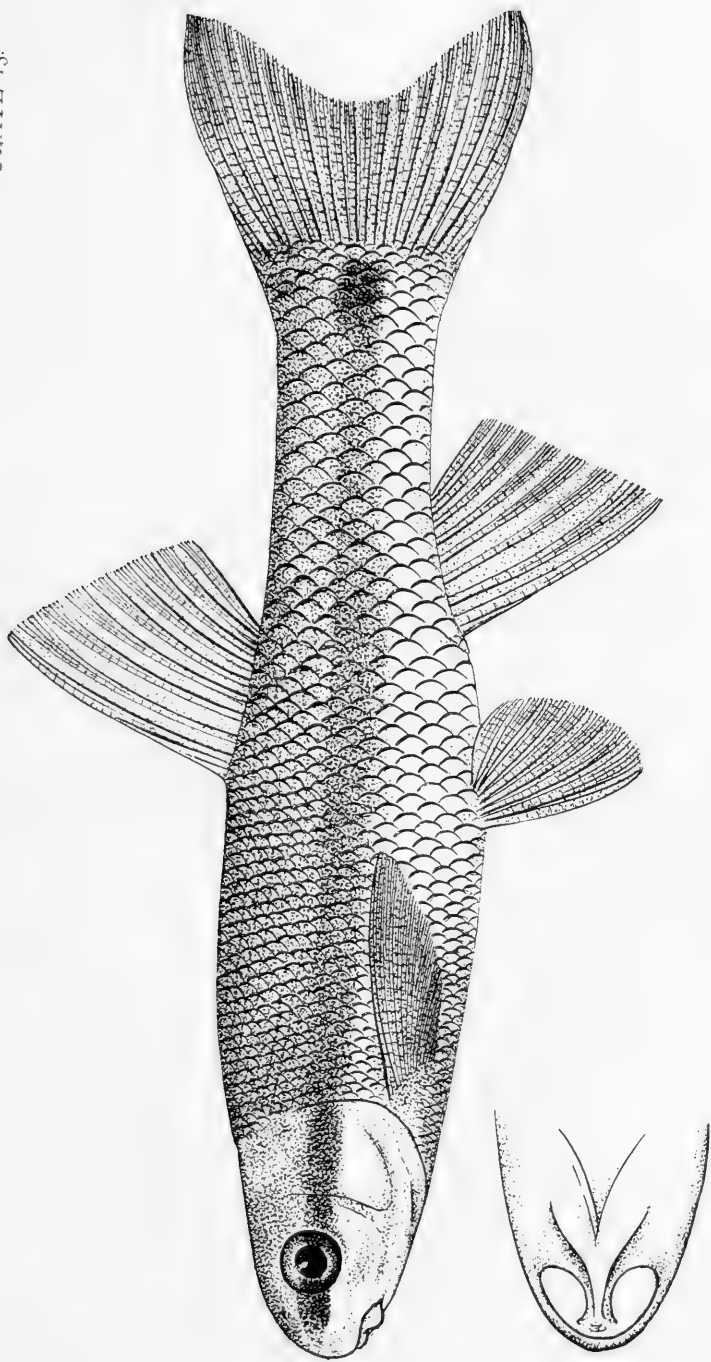
BRIDLED MINNOW. *Notropis bifrenatus* (Cope).





SWALLOW MINNOW. *Notropis procne* (Cope).





CUT LIPS MINNOW. *Exoglossum maxillingua* (Le Sueur).

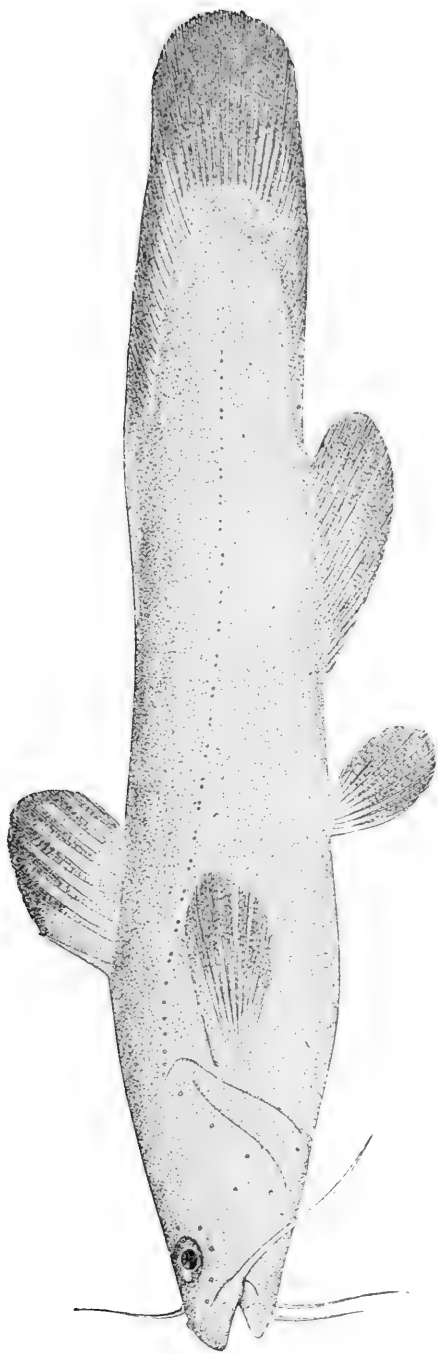




SEA CAT FISH. *Felichthys marinus* (Mitchill).

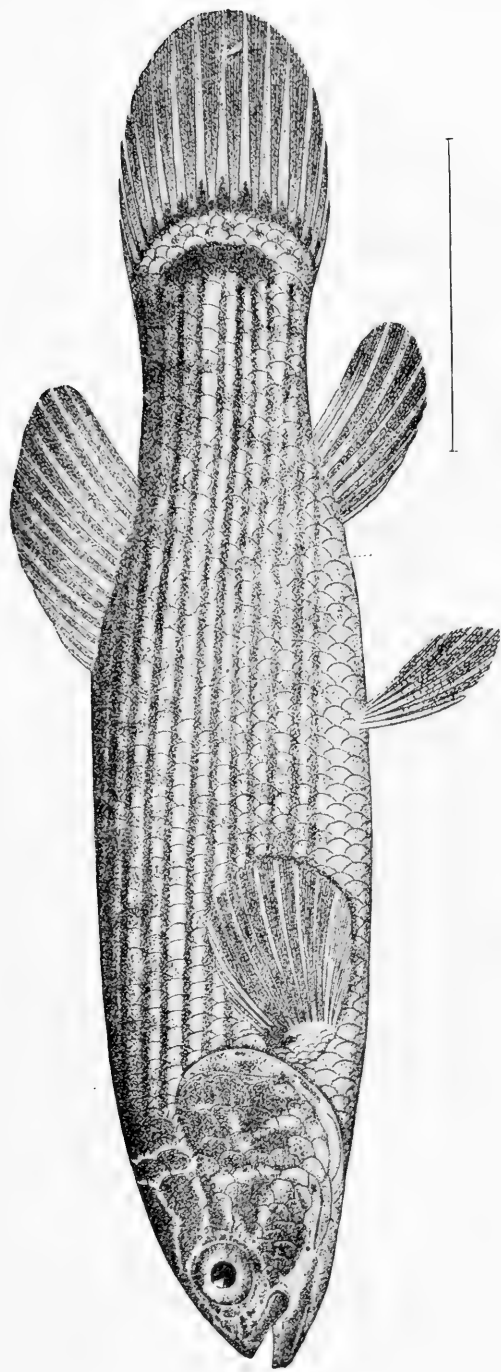






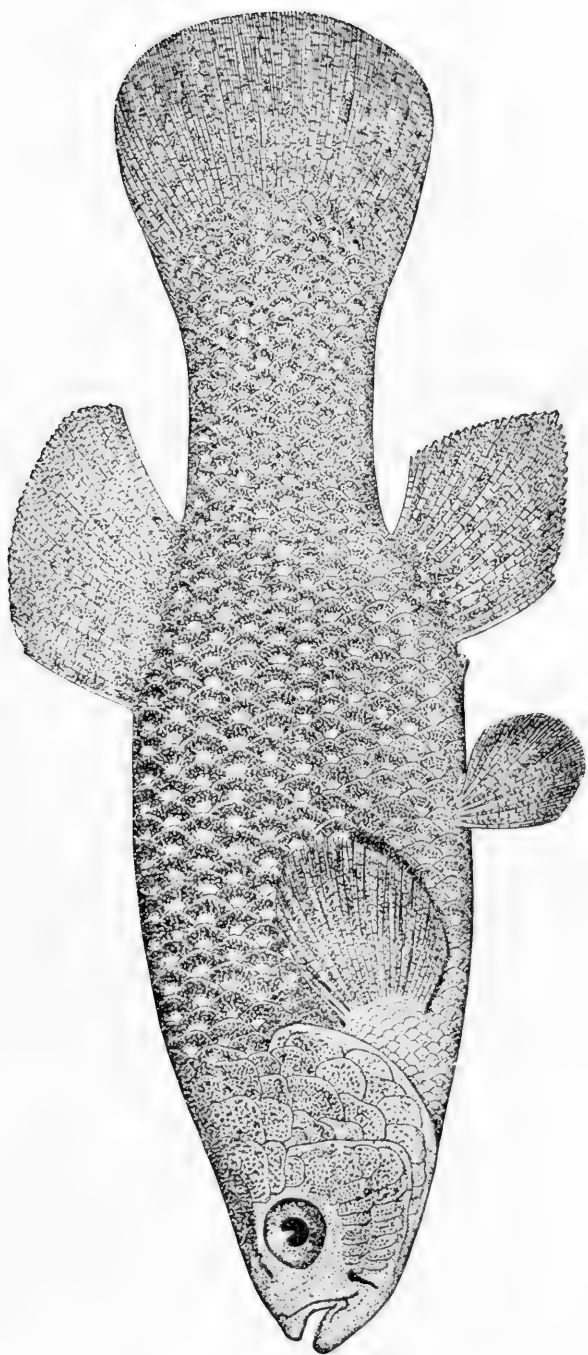
STONE CAT. *Schilbeoides insignis* (Richardson).





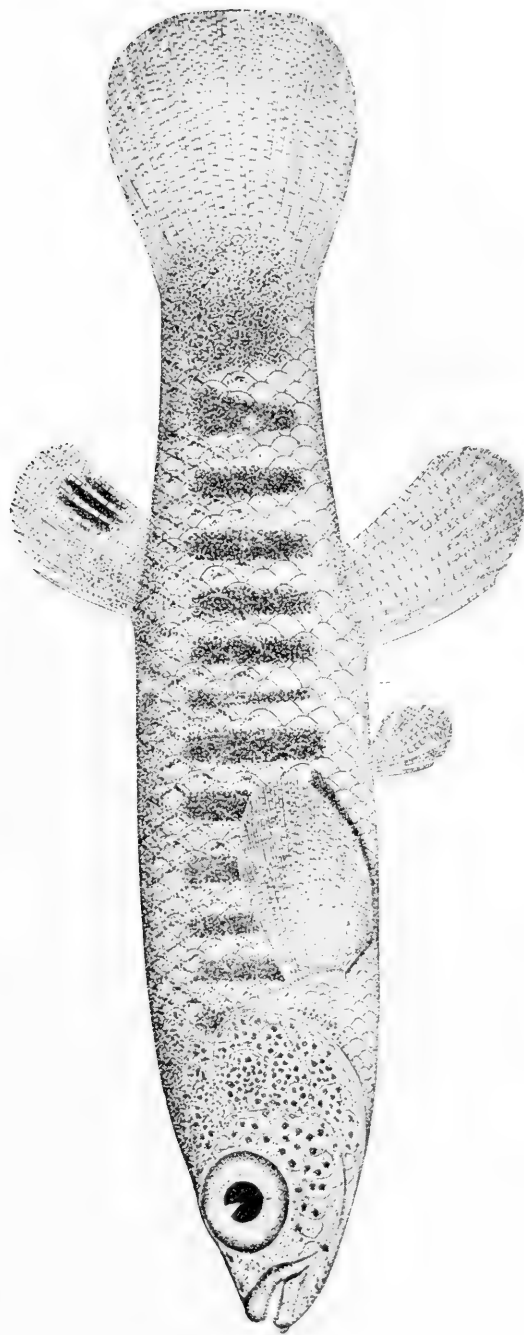
MUD MINNOW. *Umbra pygmaea* (De Kay).





MUMMICHOG. *Fundulus heteroclitus macrolepidotus* (Walbaum).

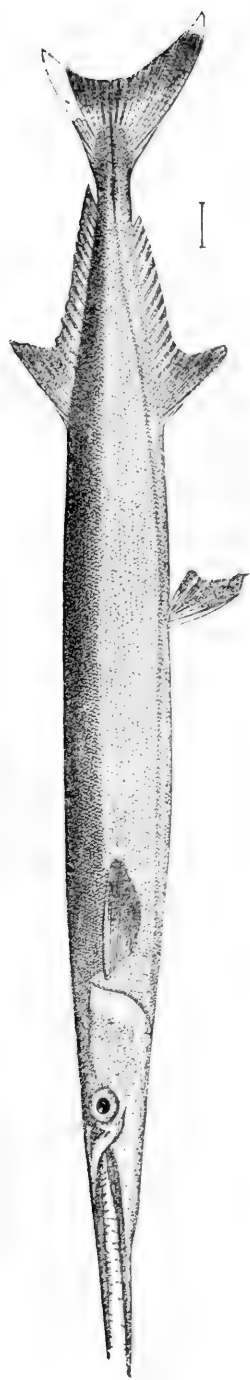




TOP MINNOW. *Zygonectes luciae* (Baird).

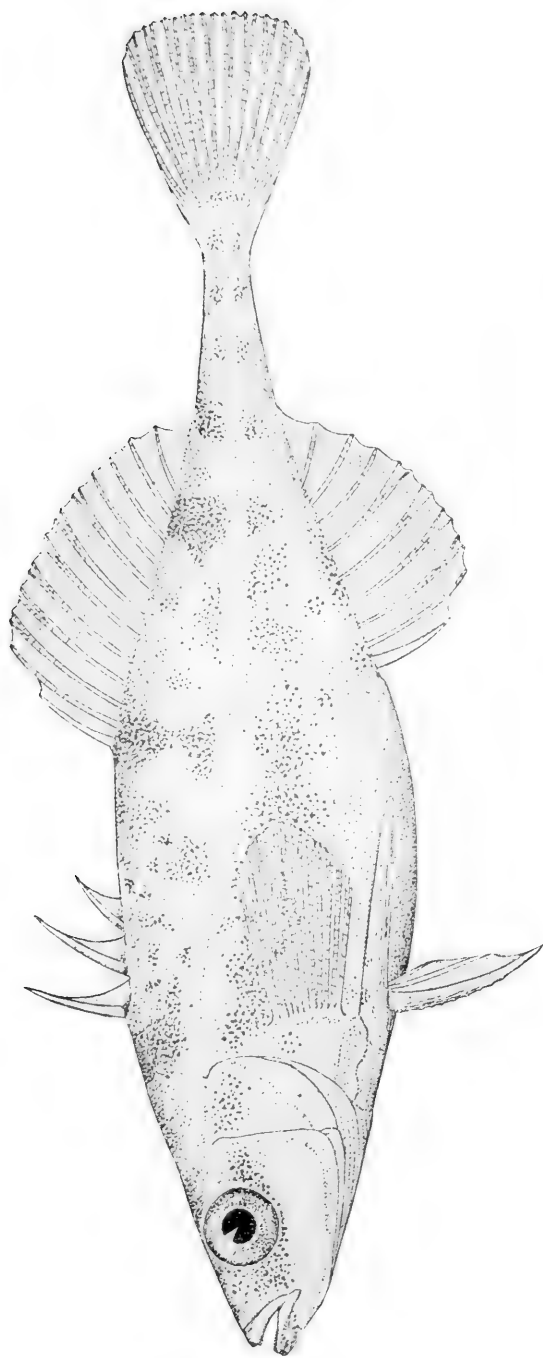






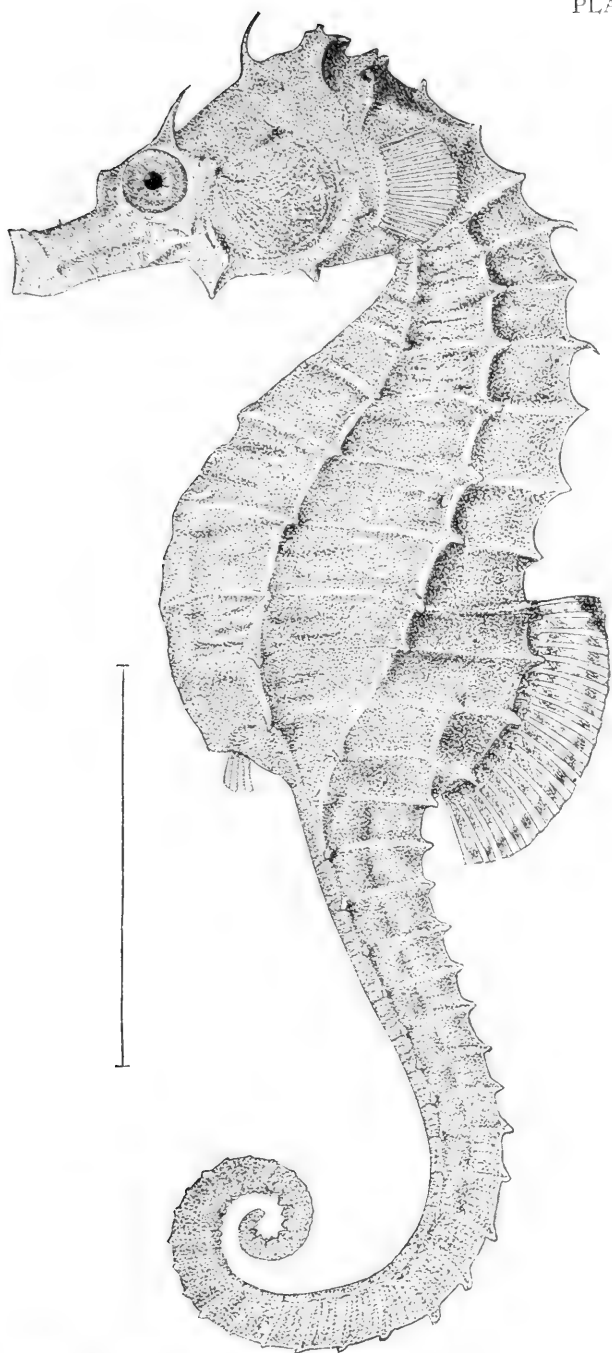
GAR. *Tylosurus raphidoma* (Ranzani).





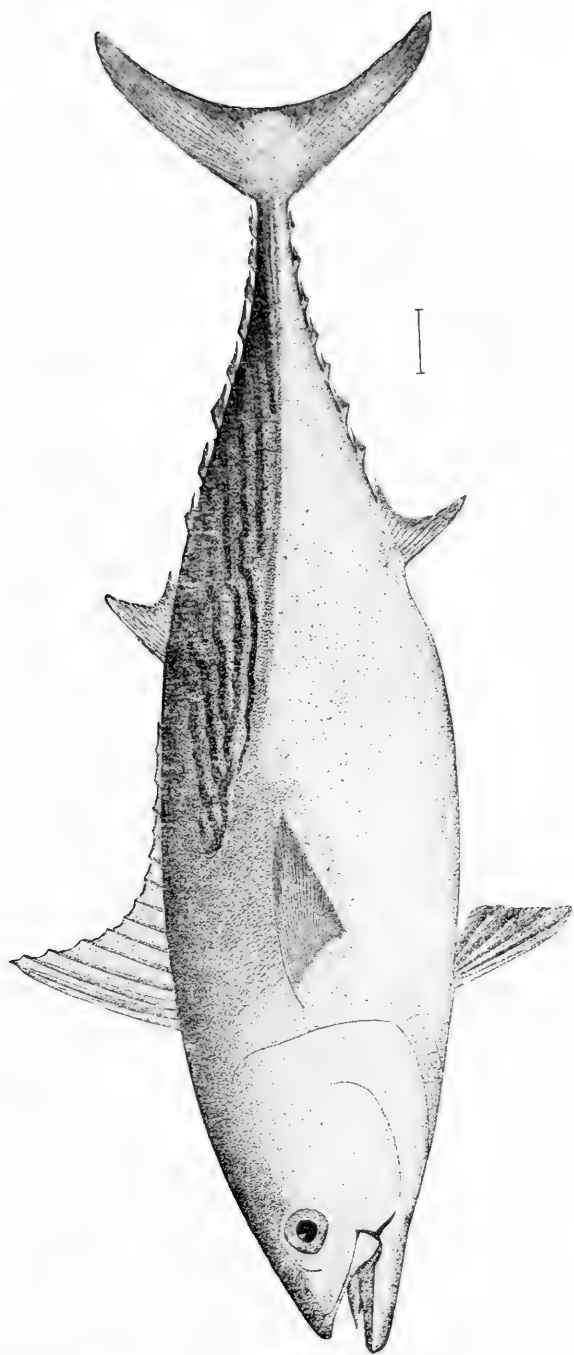
THREE SPINED STICKLEBACK. *Apeltes quadracus* (Mitchill).





SEA HORSE. *Hippocampus hudsonius* De Kay.

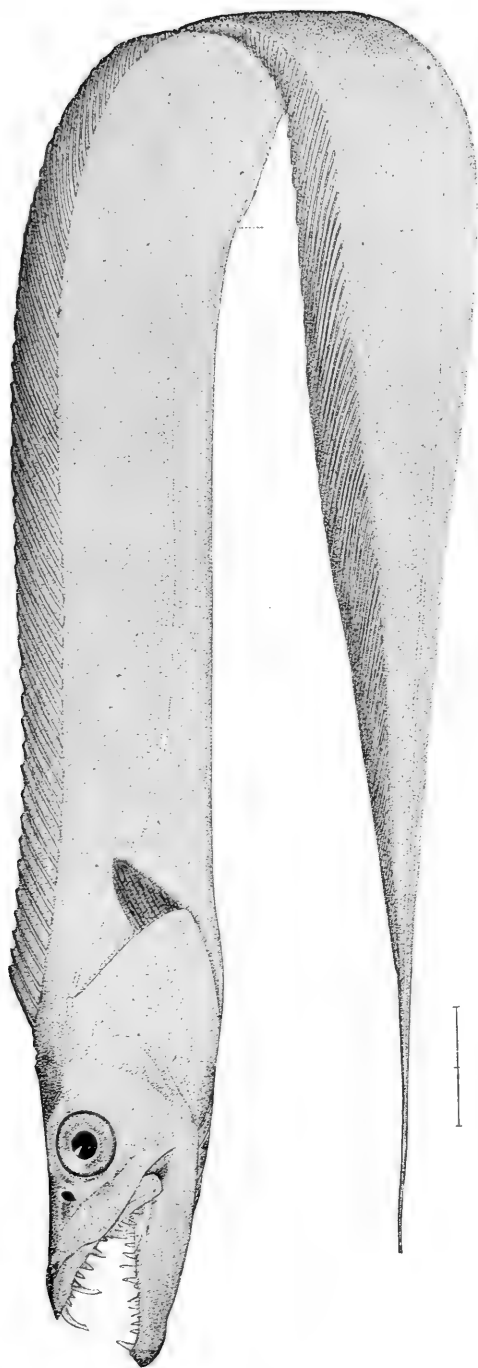




ALBACORE. *Pelamys alleterata* (Rafinesque).

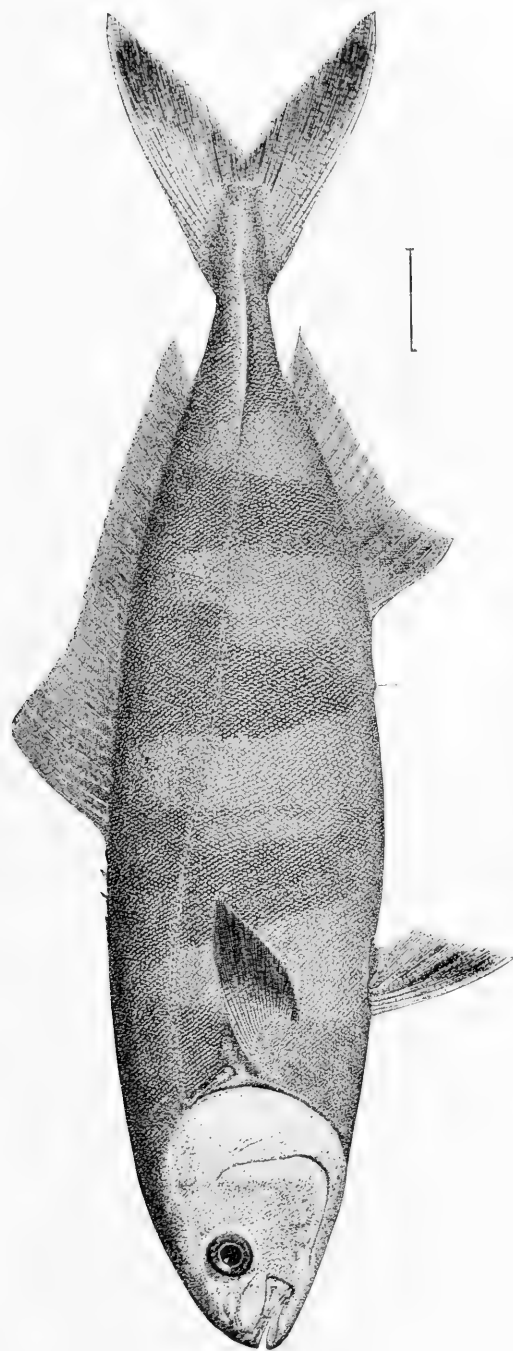






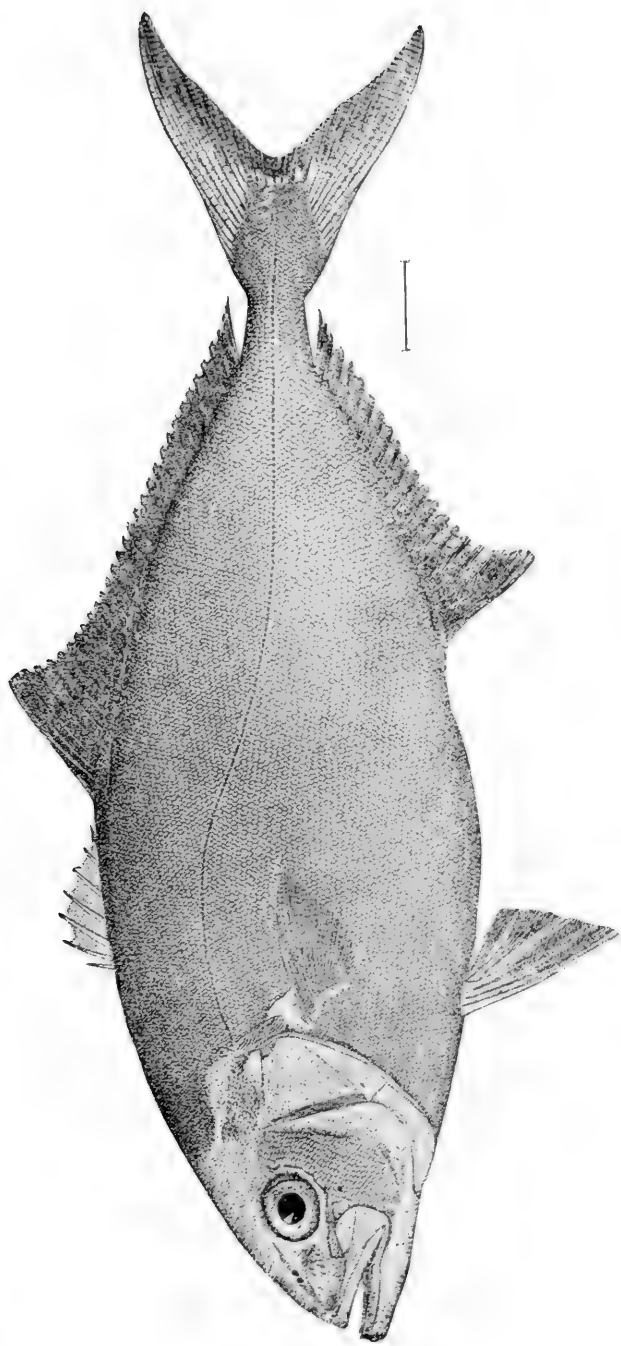
CUTLASS FISH. *Trichiurus lepturus* Linnaeus.





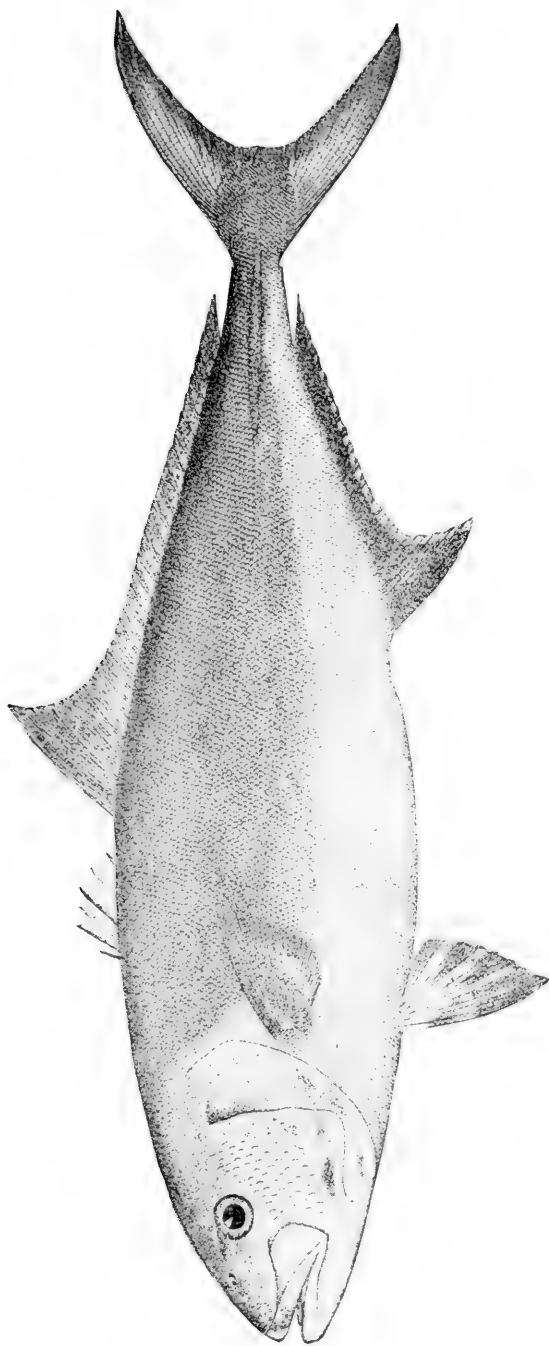
PILOT FISH. *Naucrates ductor* (Linnæus).





SHARK'S PILOT. *Seriola zonata* (Mitchill).

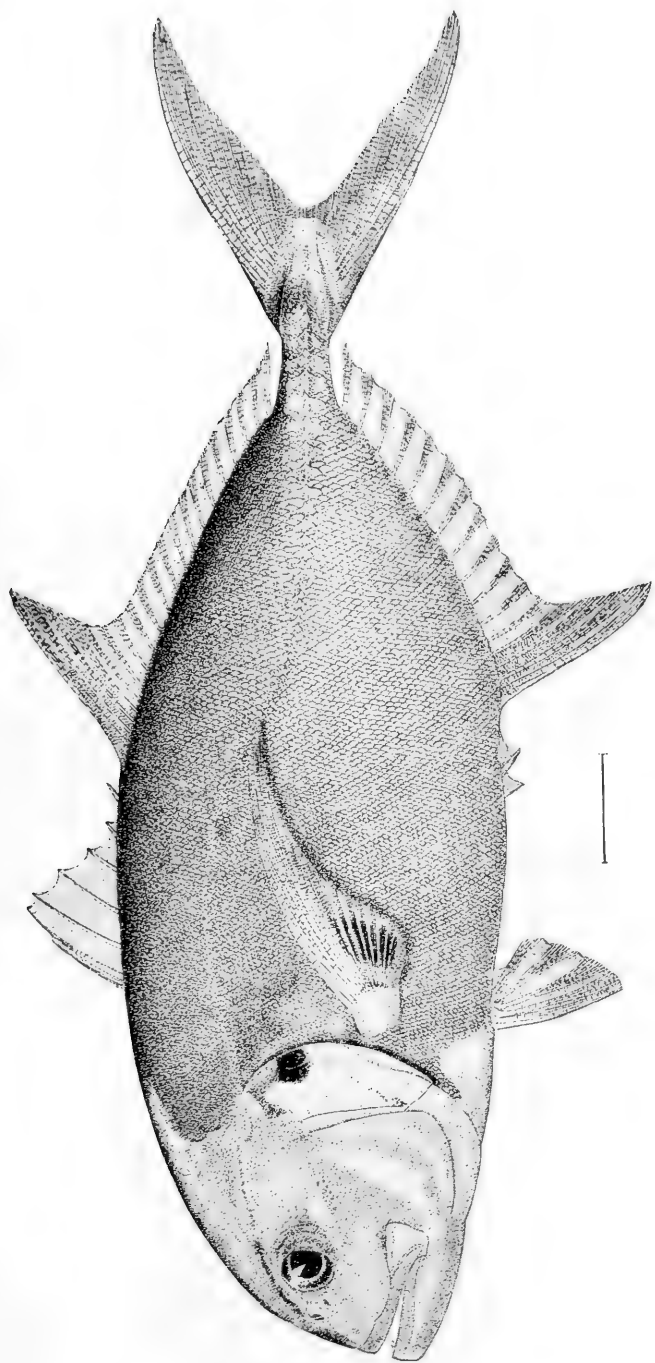




JENNY LIND. *Seriola lalandi* Valenciennes.

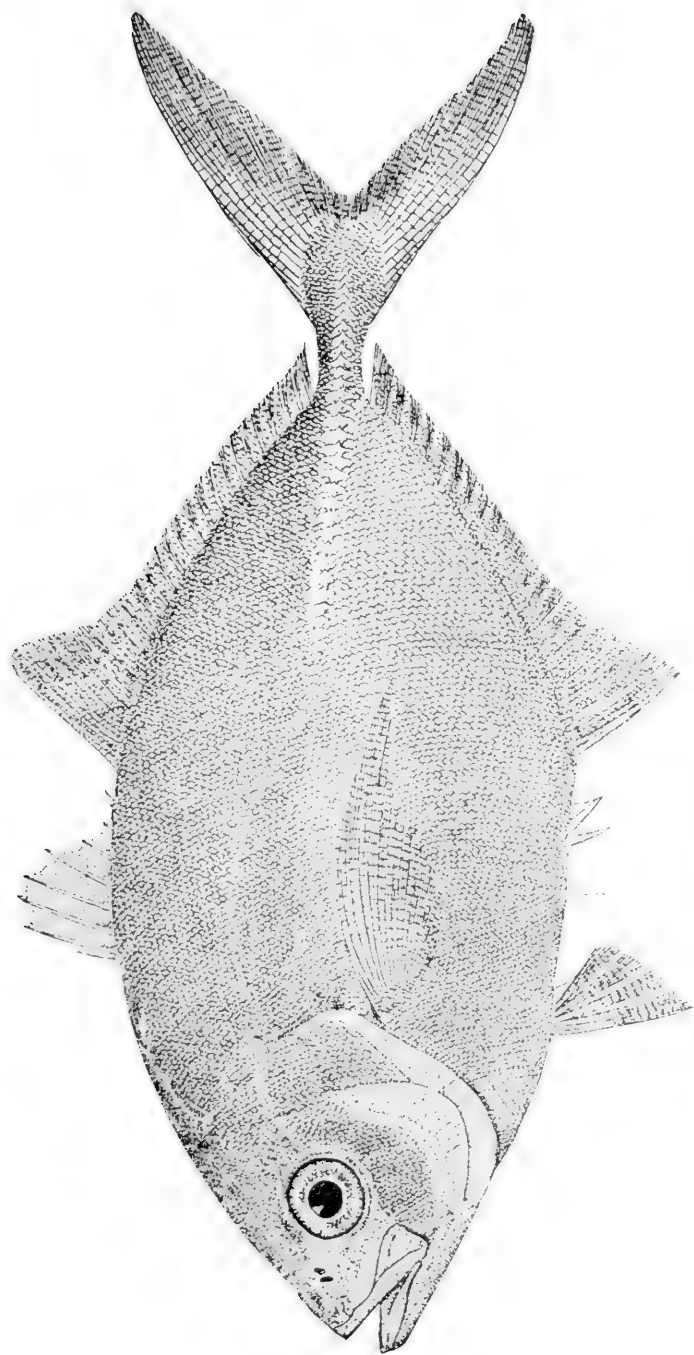






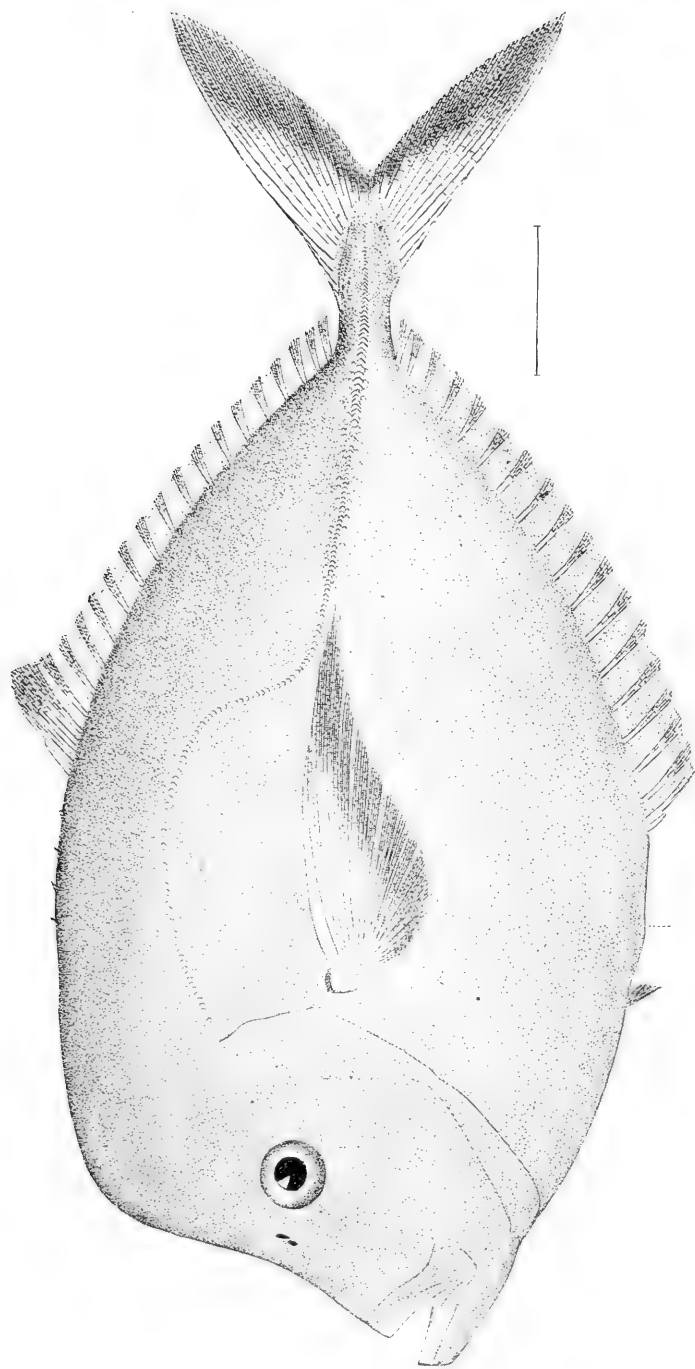
CREVALLÉ. *Caranx hippos* (Linnæus).





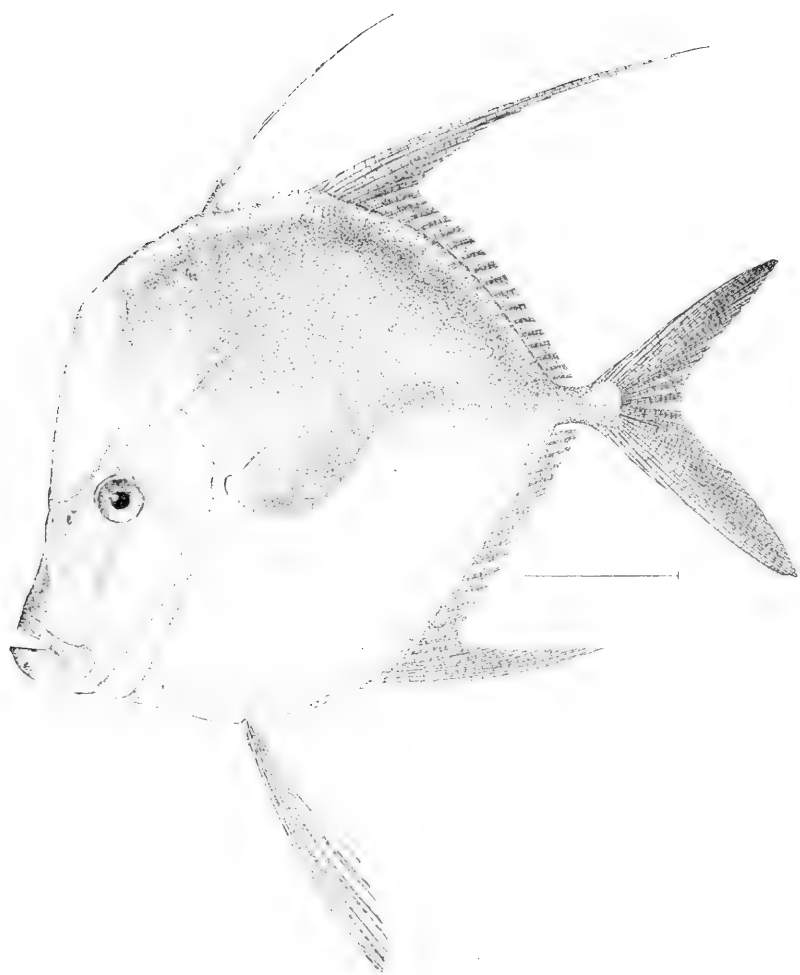
JUREL. *Caranx latus* Agassiz.





MOON FISH. *Vomer setapinnis* (Mitchill).



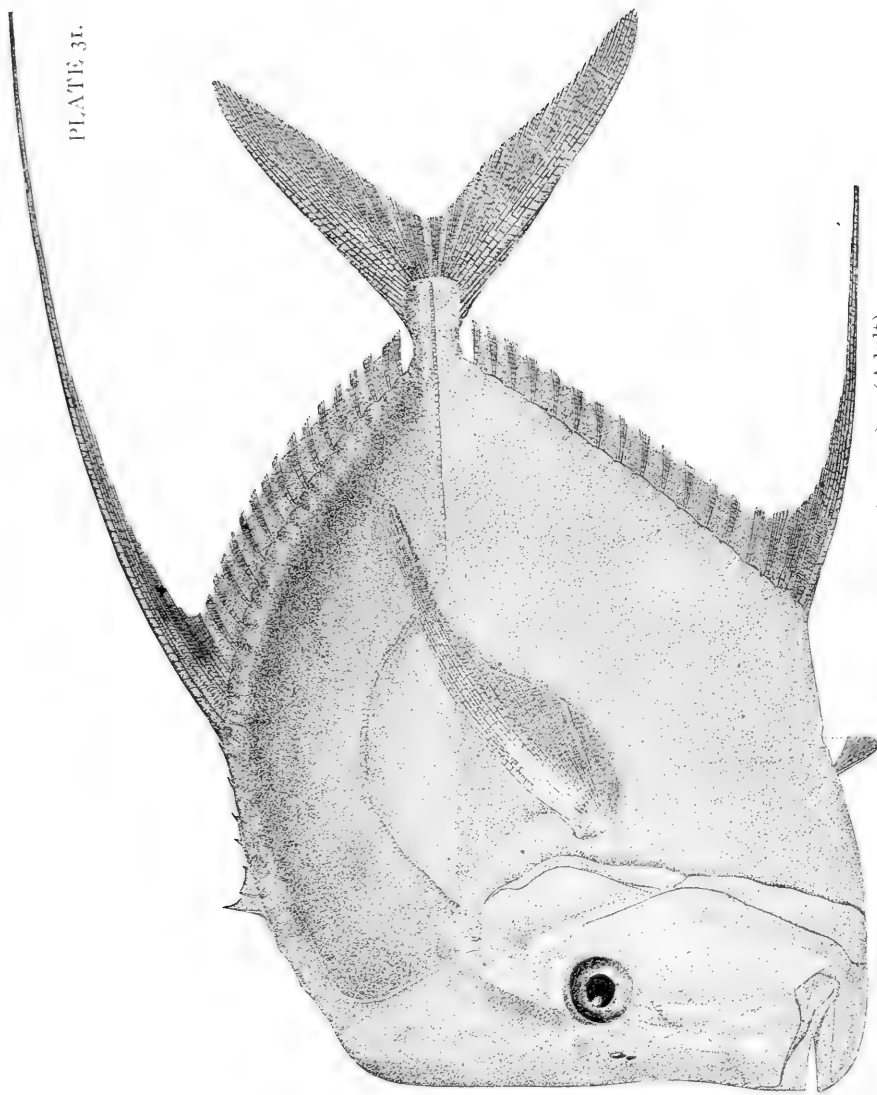


DOLLAR FISH. *Selene vomer* (Linnæus). (Young.)

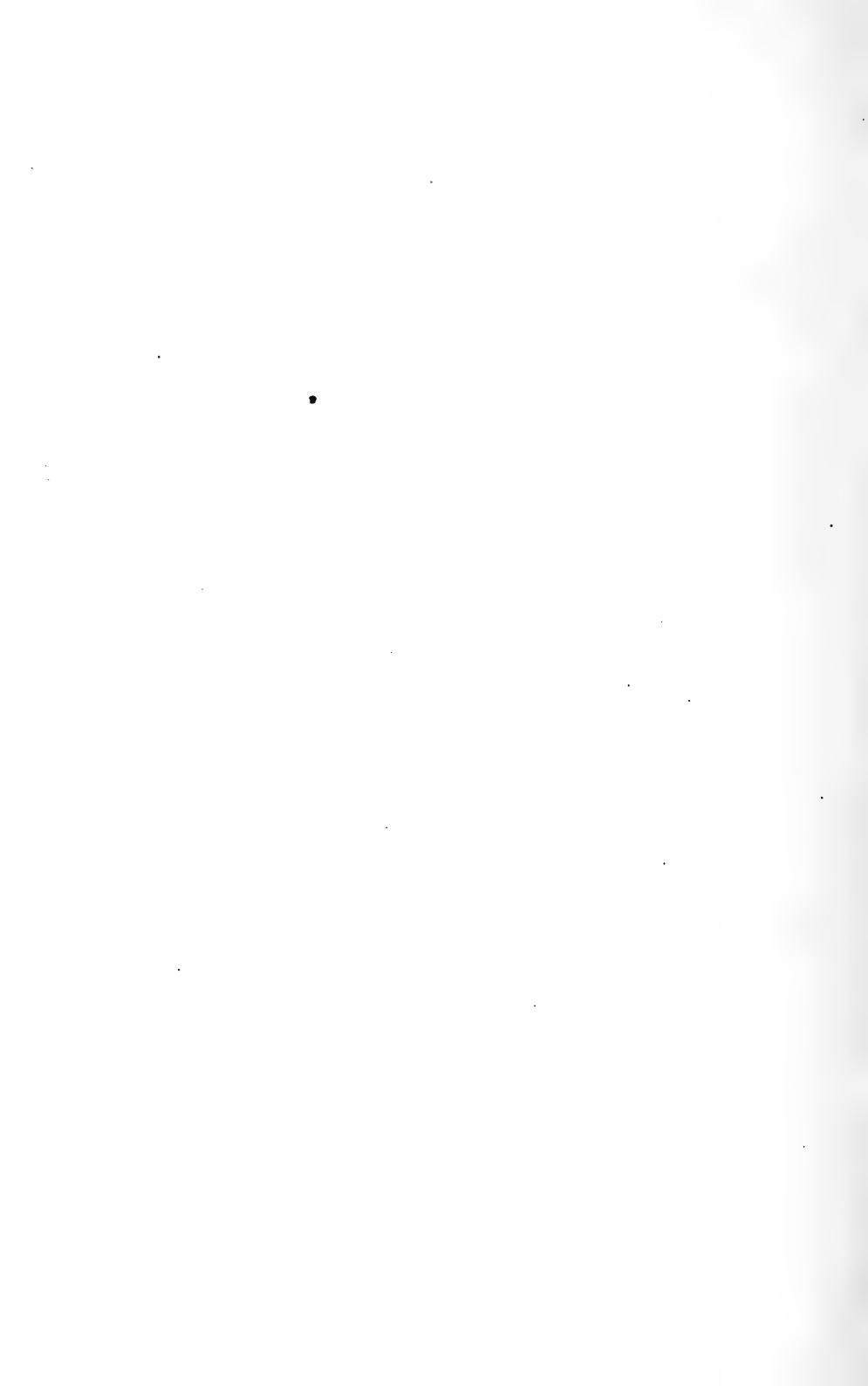


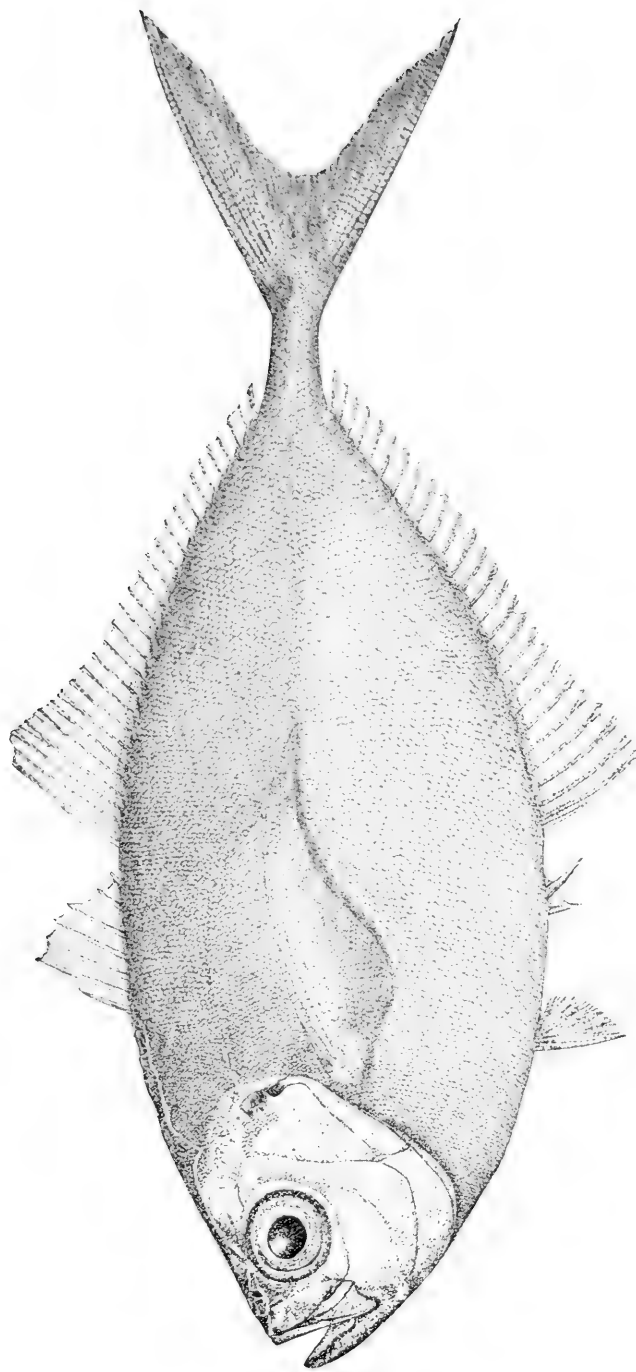


PLATE, 31.



DOLLAR FISH. *Selene vomer* (Linnaeus). (Adult).





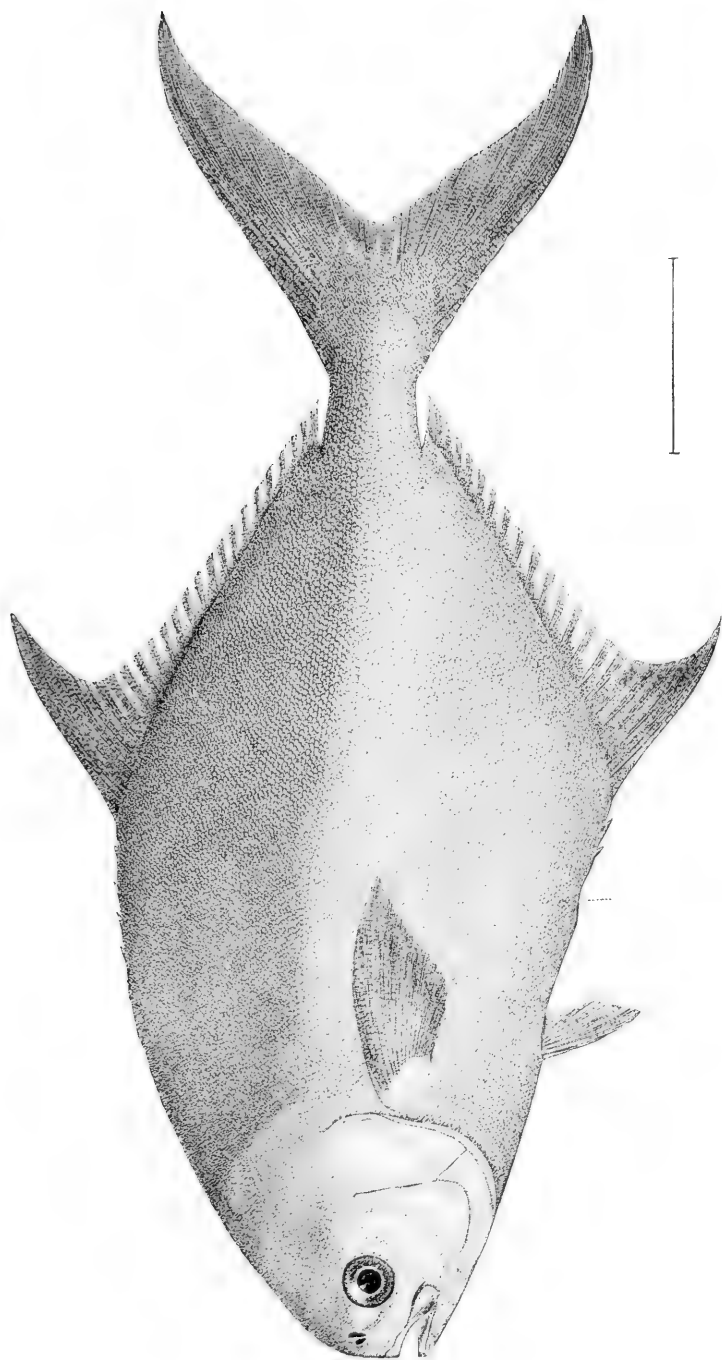
YELLOW TAIL. *Chloroscombrus chrysurus* (Linnæus).





ROUND PAMPANO. *Trachinotus falcatus* (Linnæus).

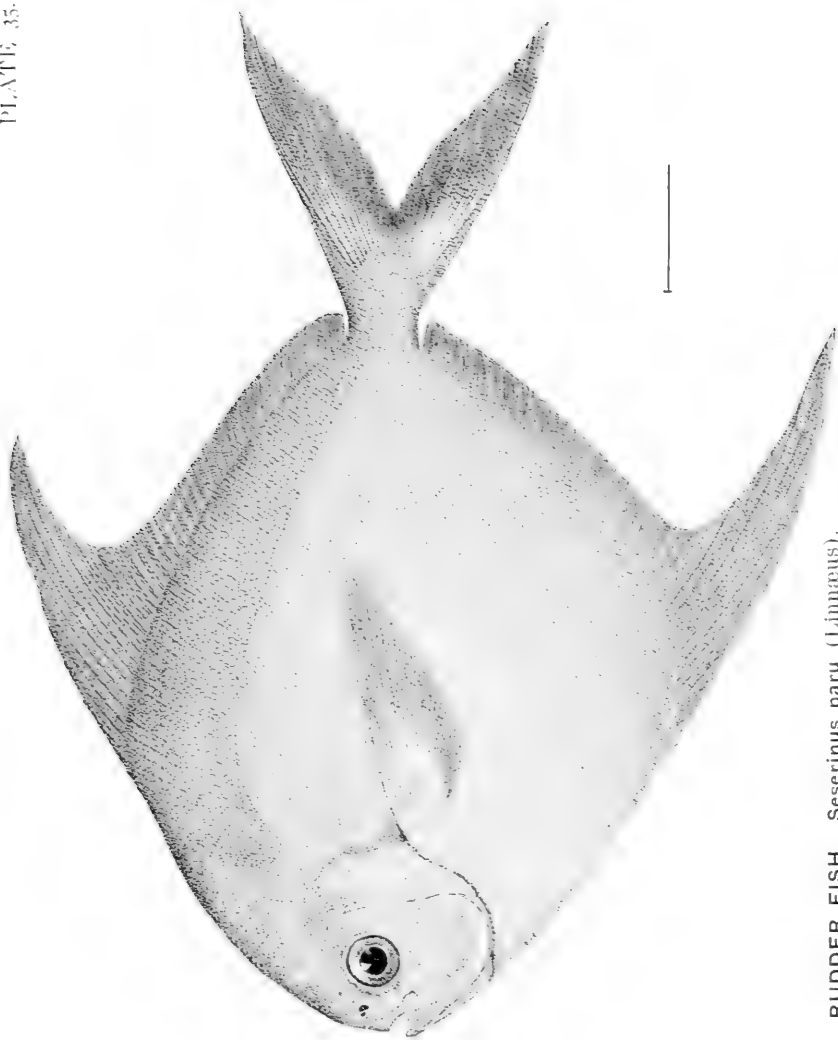




COMMON PAMPANO. *Trachinotus carolinus* (Linnæus).

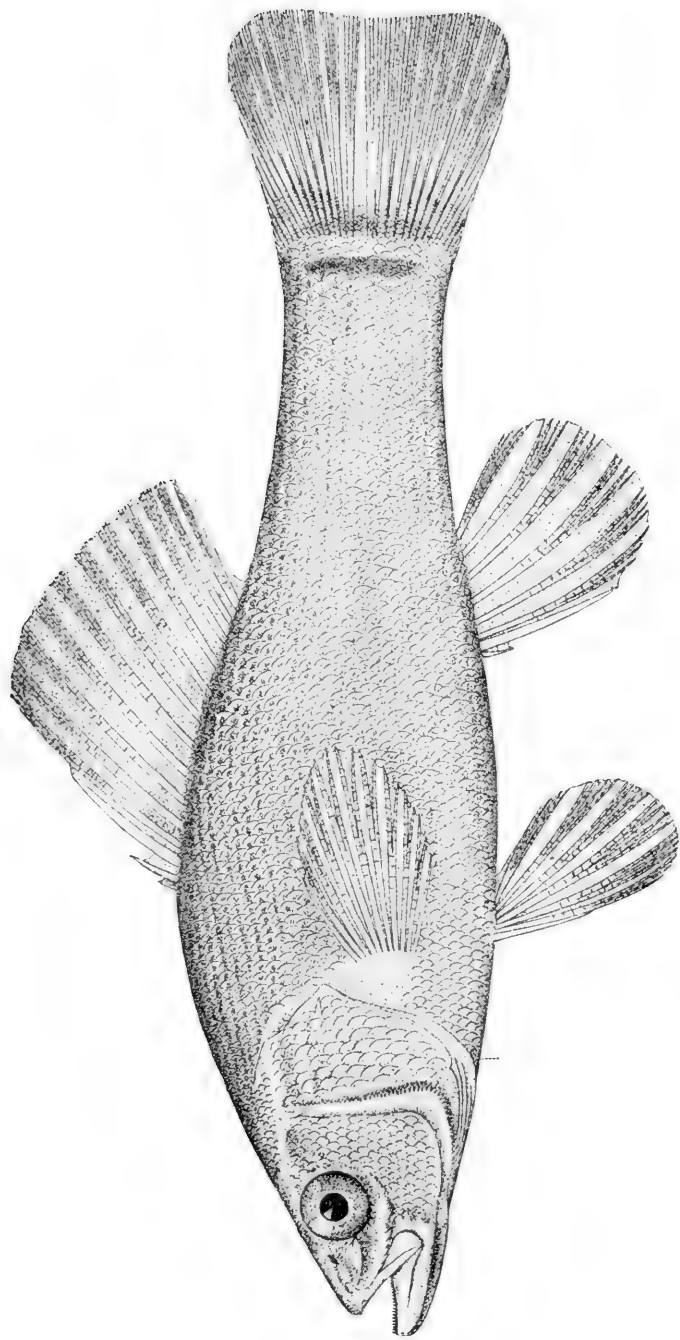






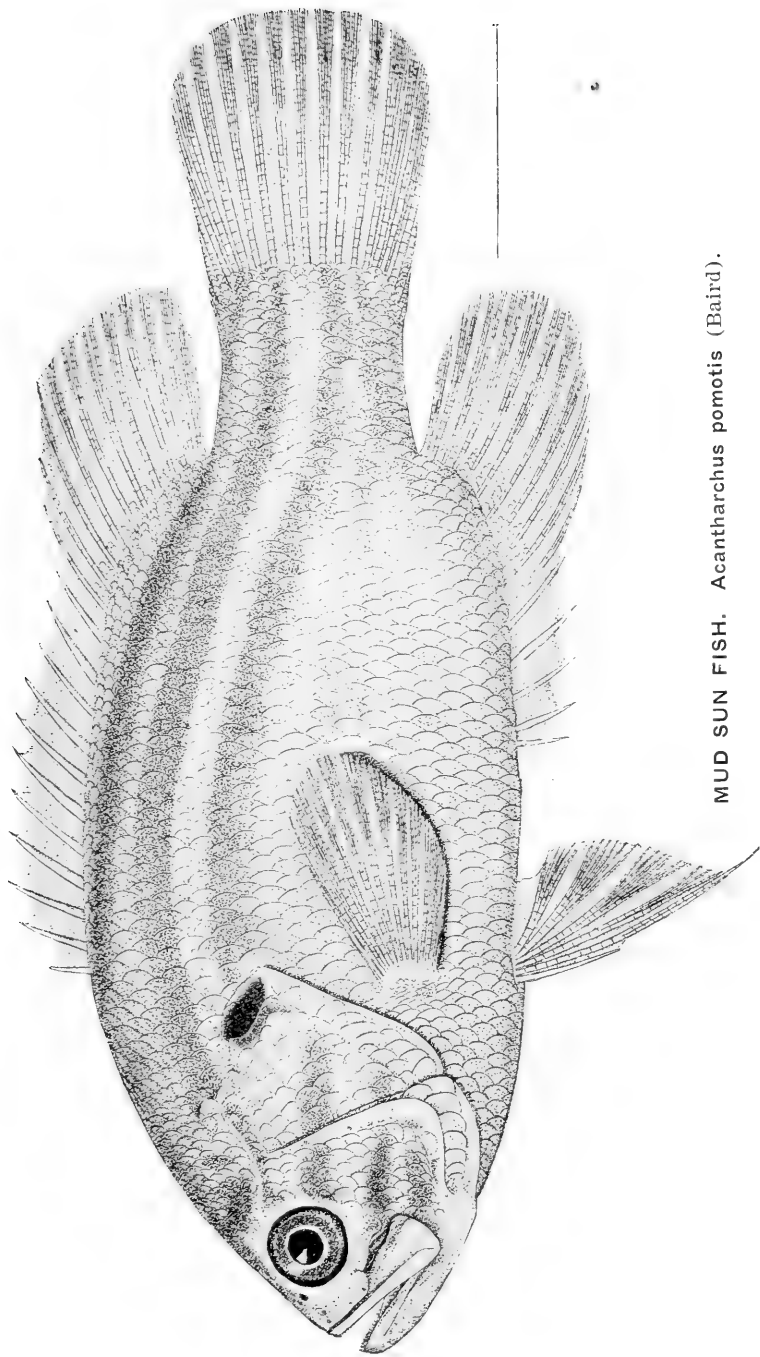
RUDDER FISH. *Seserinus paru* (Linnaeus).





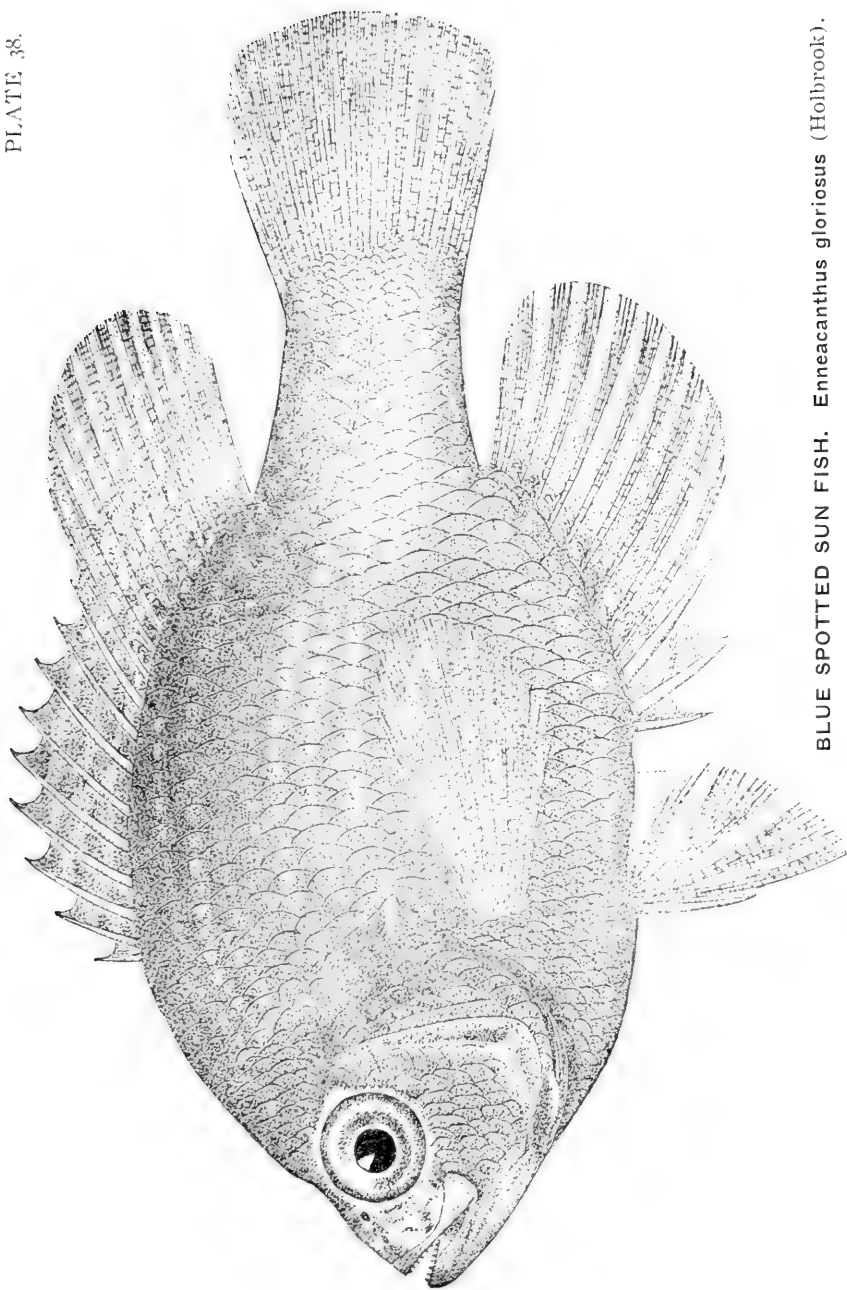
PIRATE PERCH. *Aphredoderus sayanus* (Gilliams).





MUD SUN FISH. *Acantharchus pomotis* (Baird).

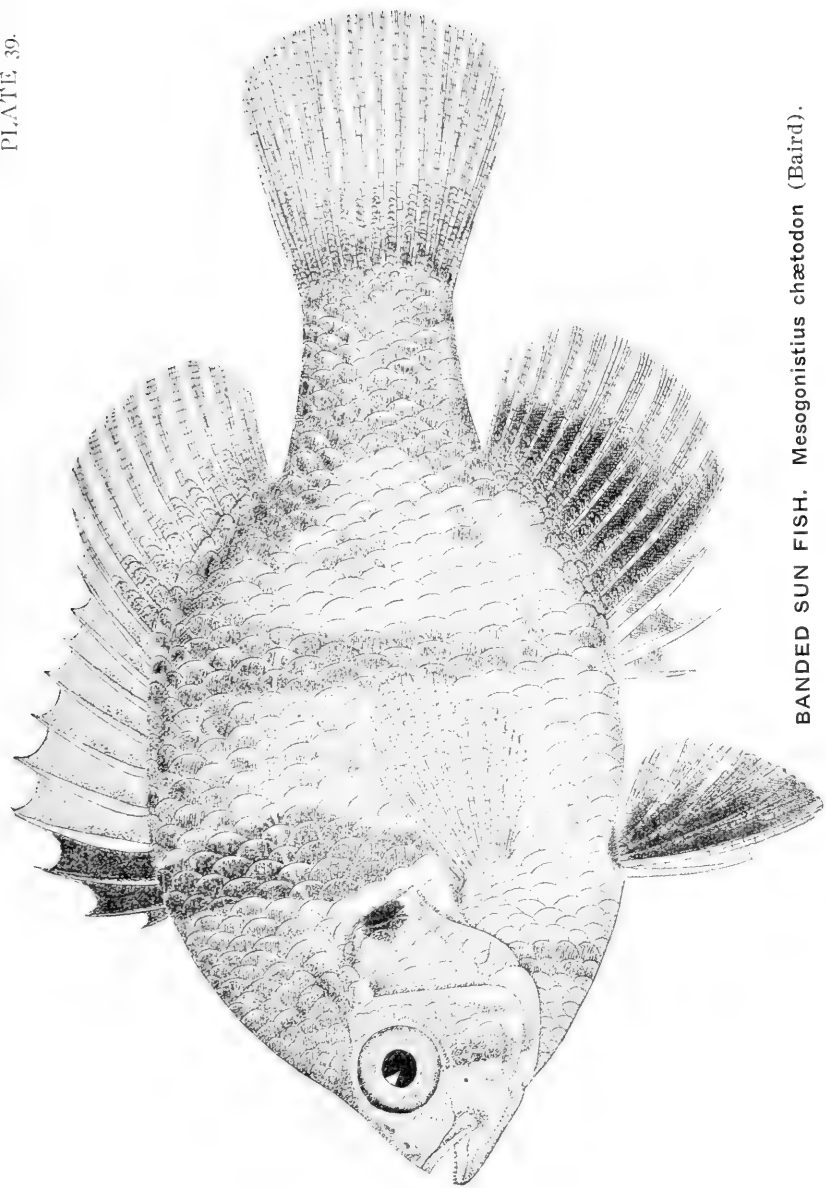




BLUE SPOTTED SUN FISH. *Enneacanthus gloriosus* (Holbrook).

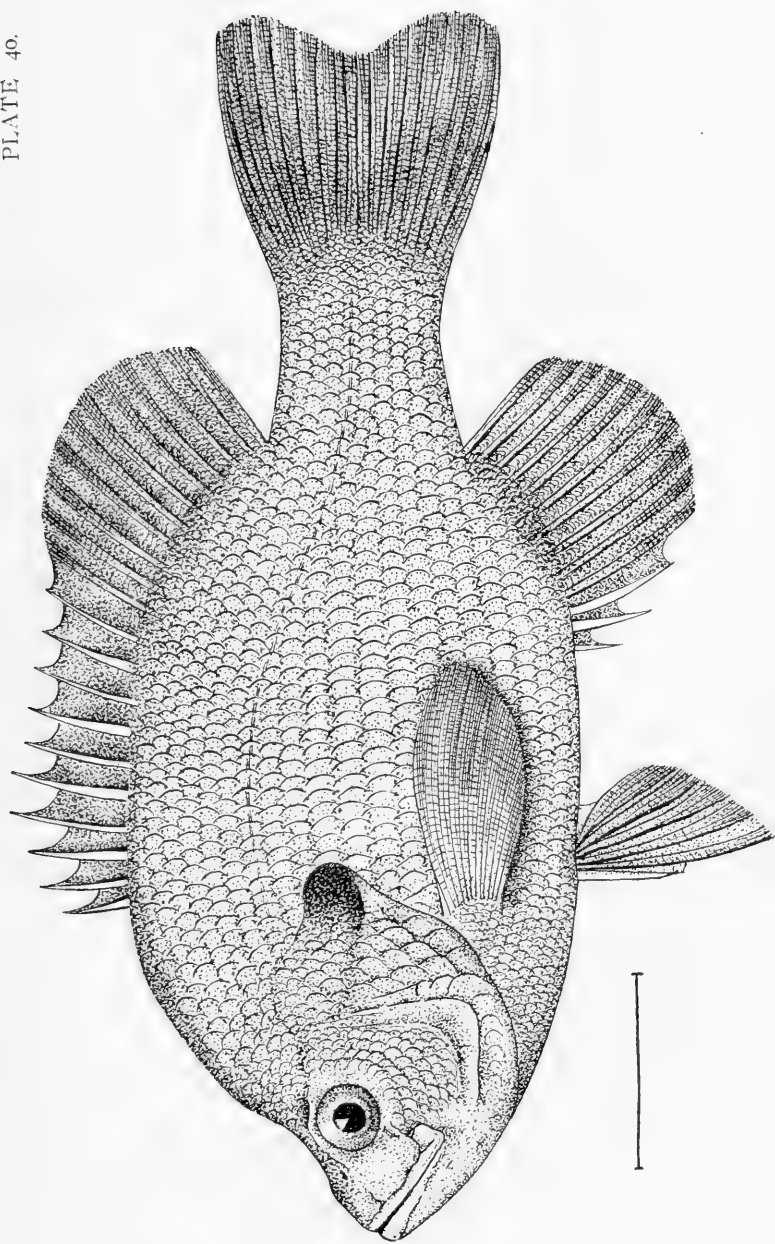






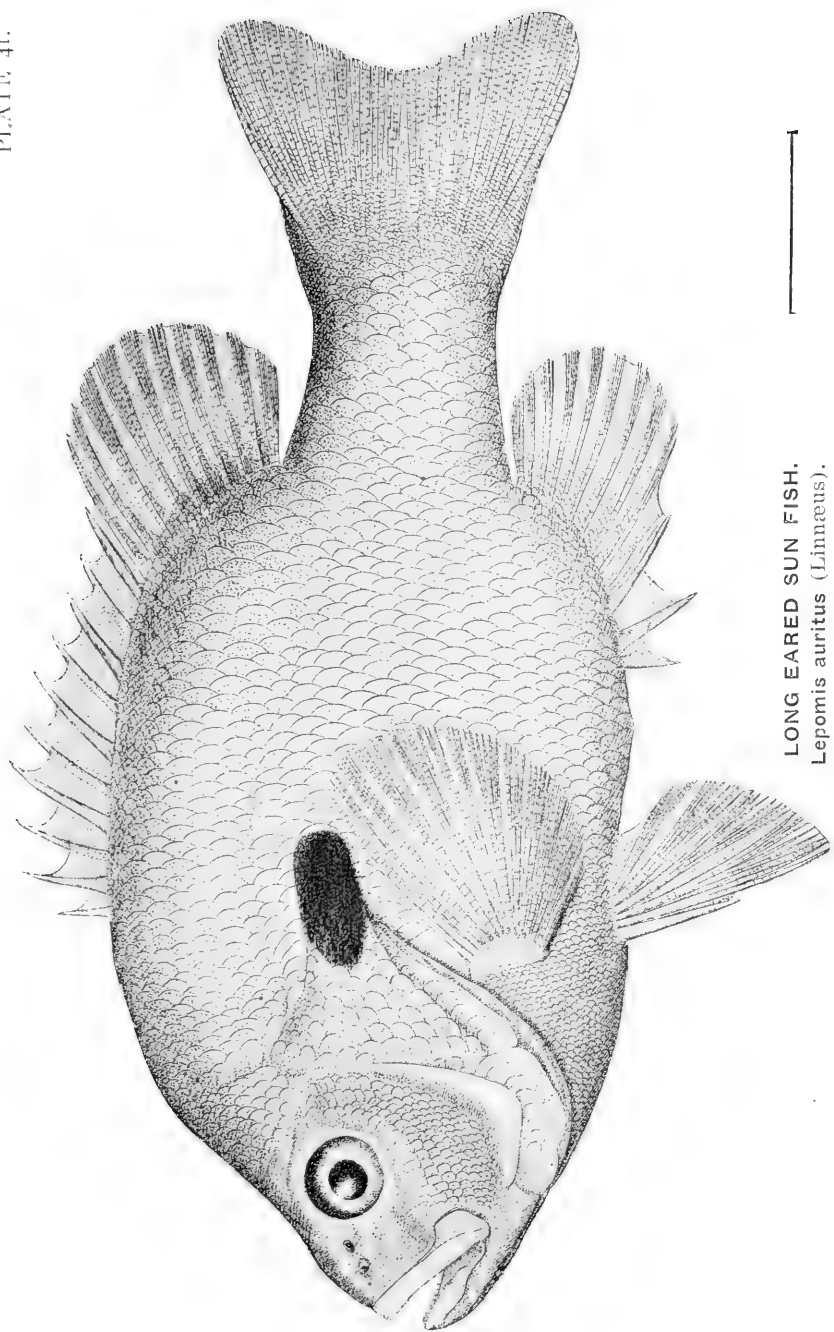
BANDED SUN FISH. *Mesogonistius chætodon* (Baird).





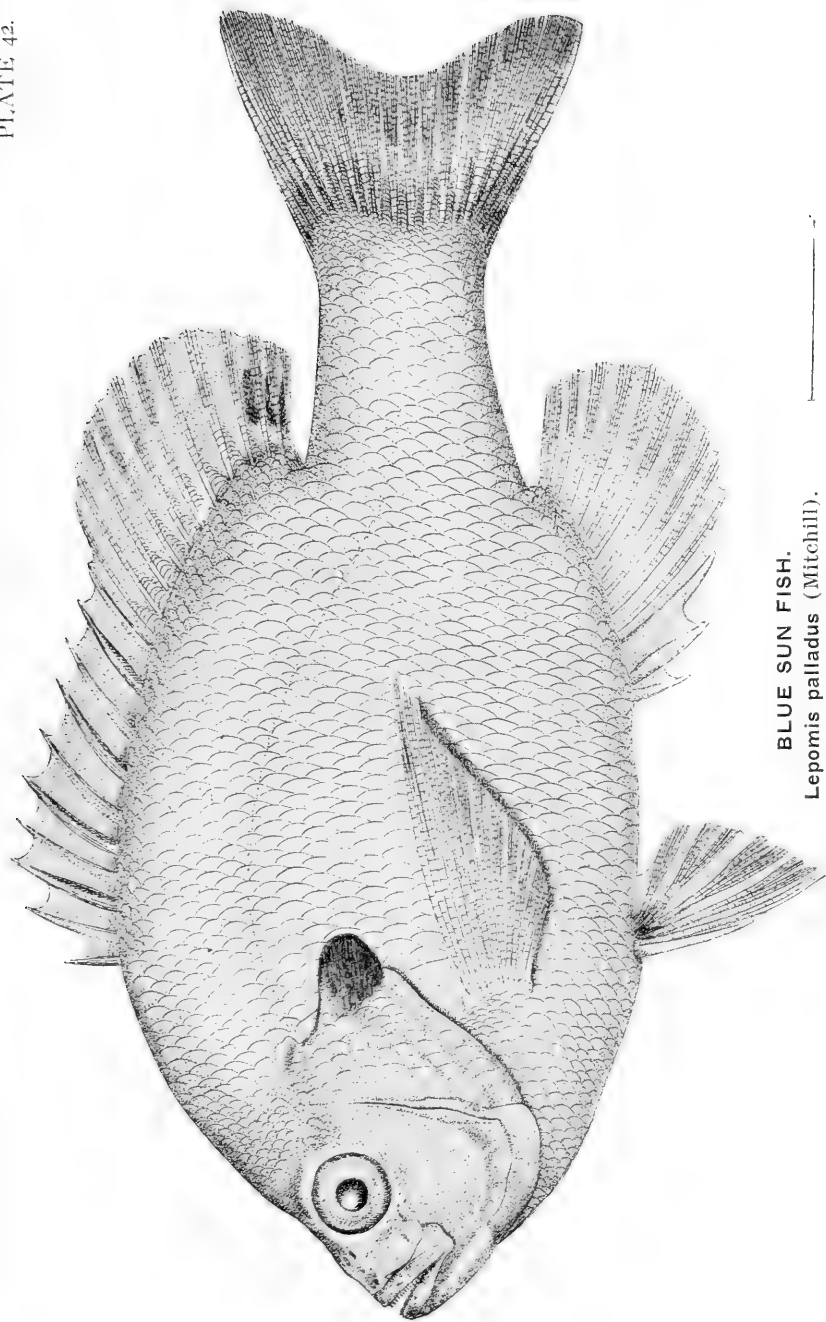
DECEPTIVE SUN FISH. *Lepomis phenax* (Jordan).





LONG EARED SUN FISH.  
*Lepomis auritus* (Linnaeus).



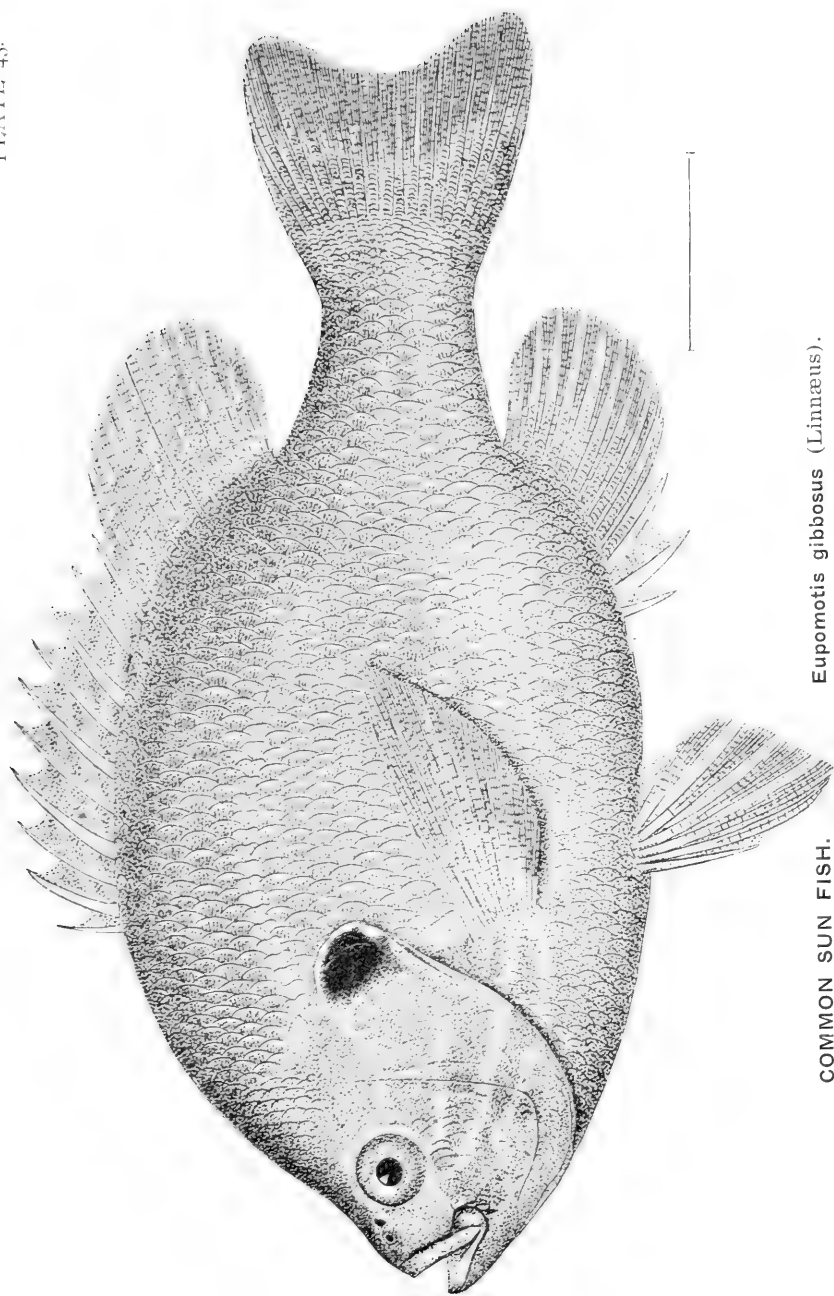


BLUE SUN FISH.

*Lepomis pallidus* (Mitchill).



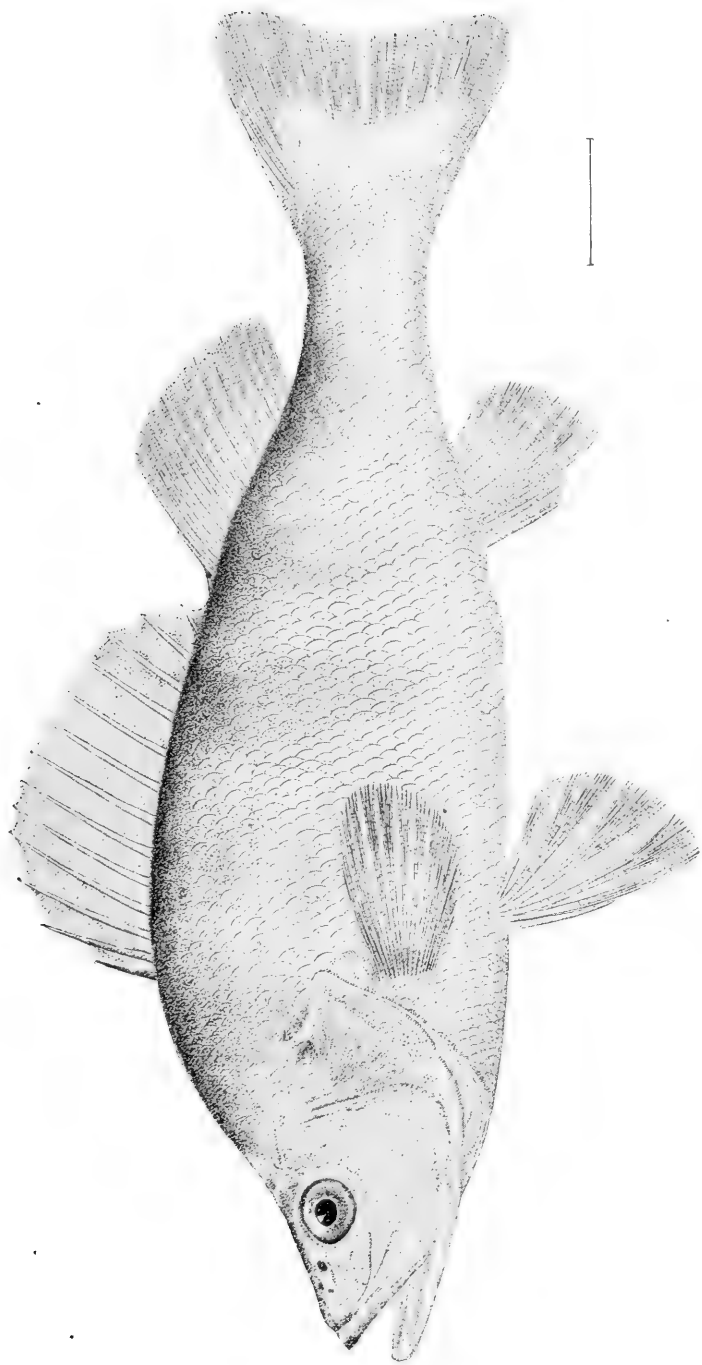




*Eupomotis gibbosus* (Linnaeus).

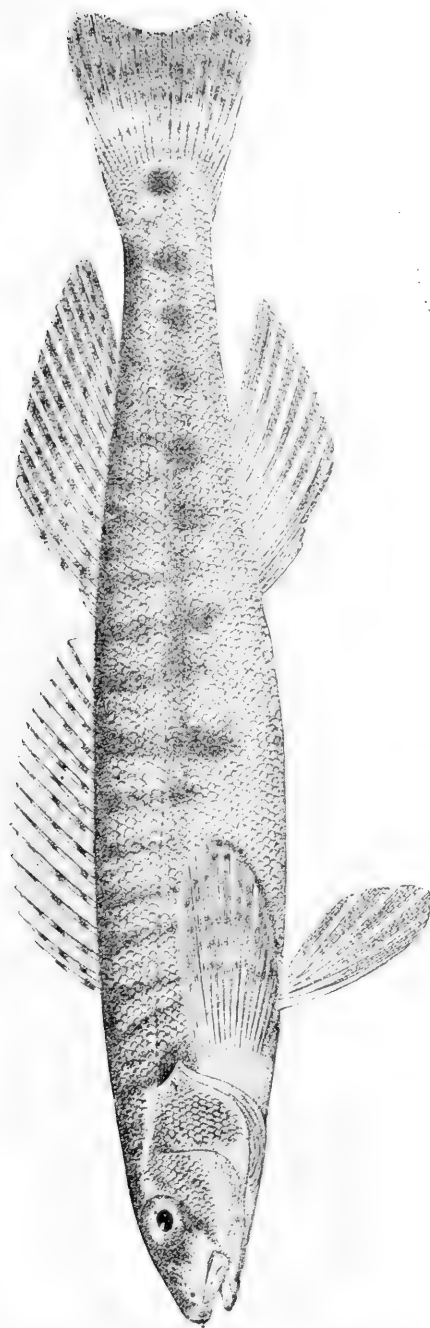
COMMON SUN FISH.





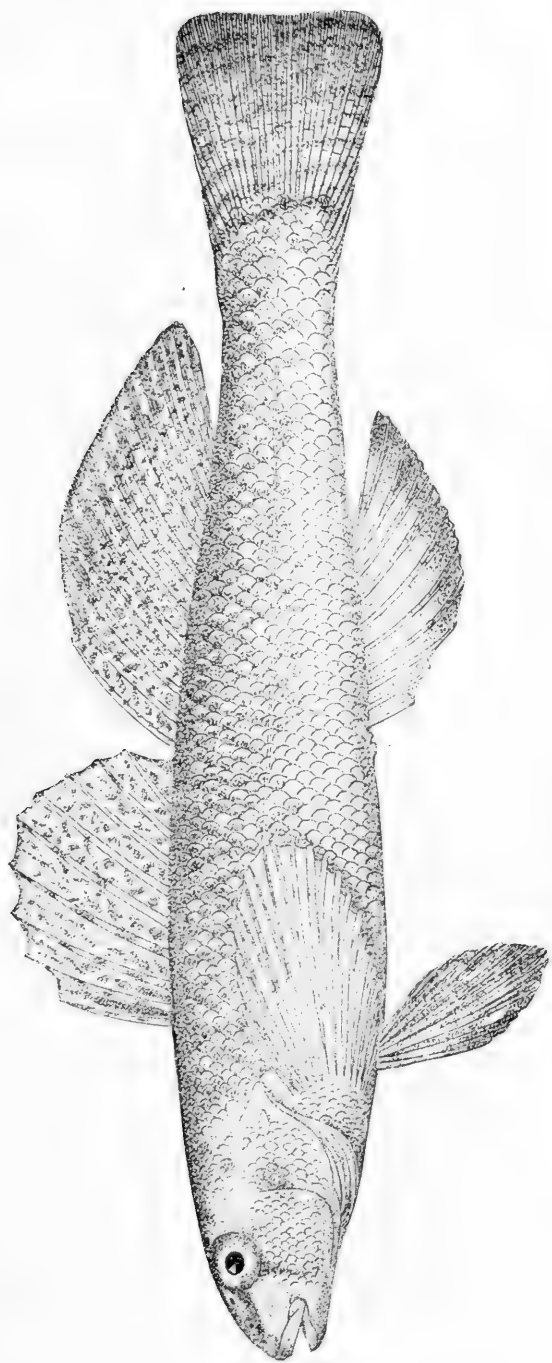
YELLOW PERCH. *Perca flavescens* (Mitchill).





SAND PERCH. *Percina caprodes* (Rafinesque).

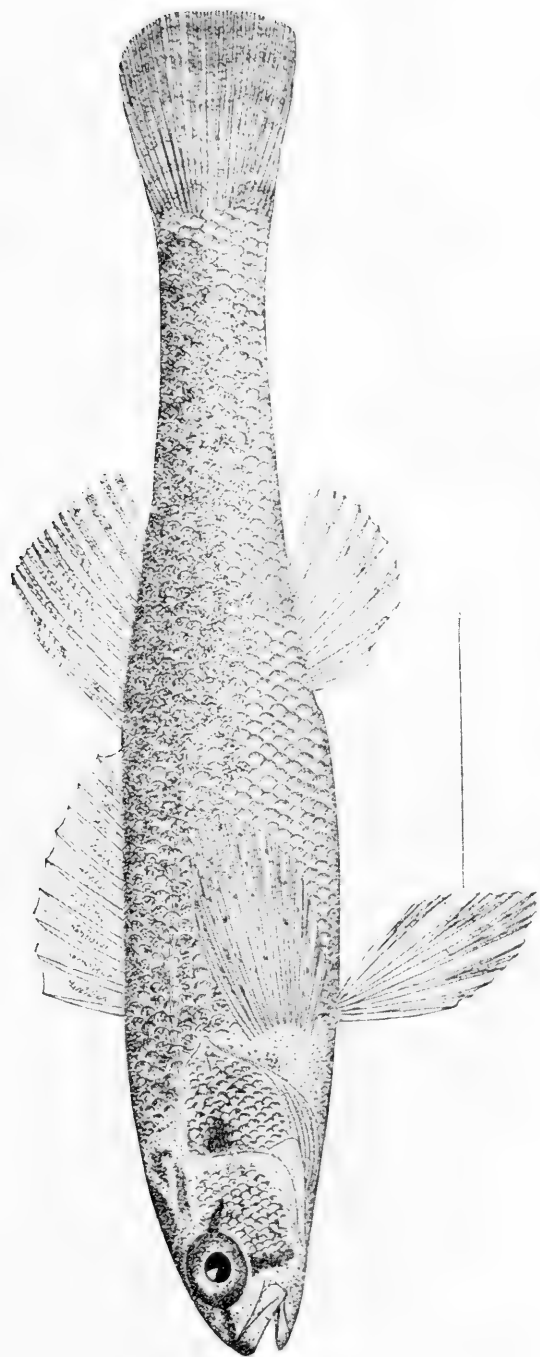




TESSELLATED DARTER. *Boleosoma nigrum olmstedii* (Storer).

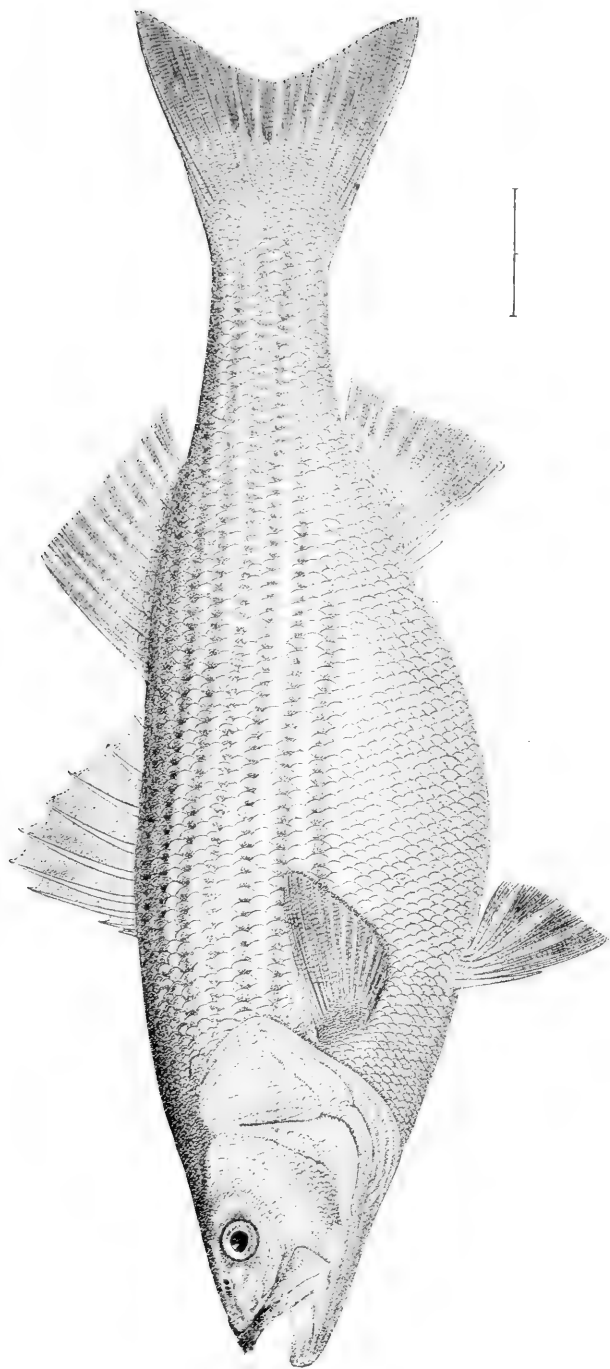






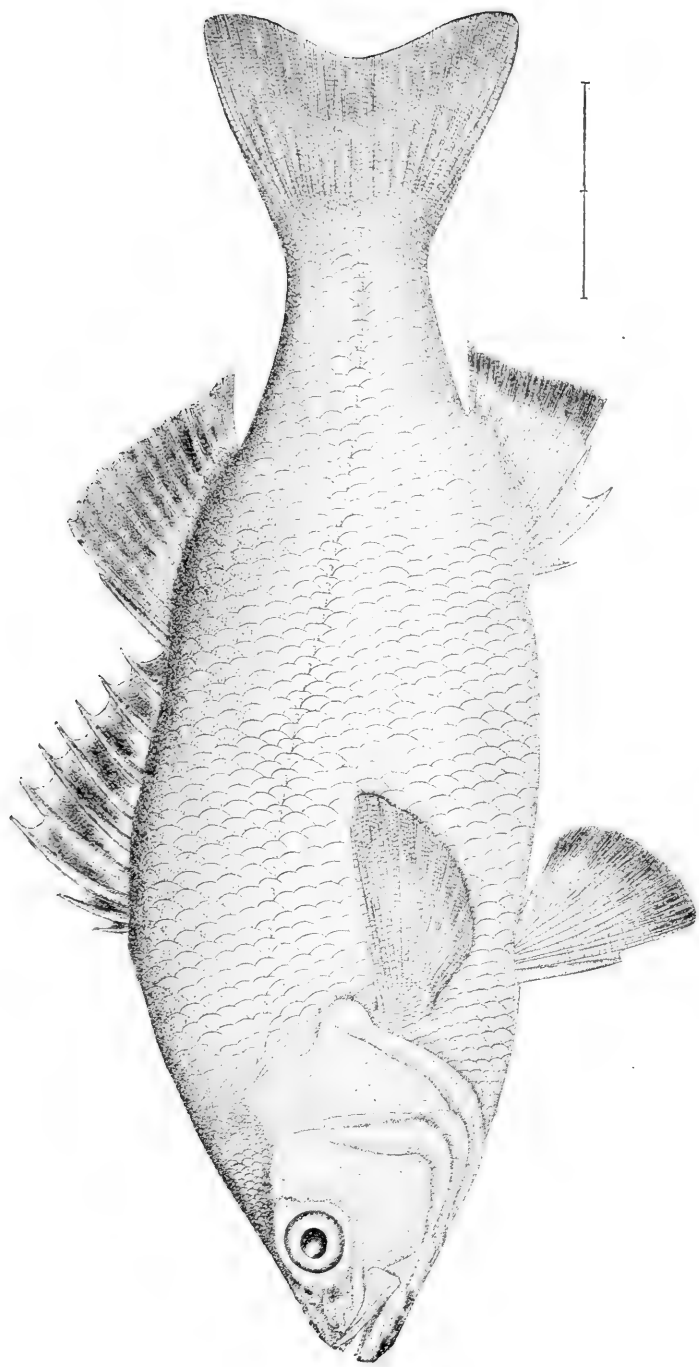
FUSIFORM DARTER. *Boleichthys fusiformis* (Girard).





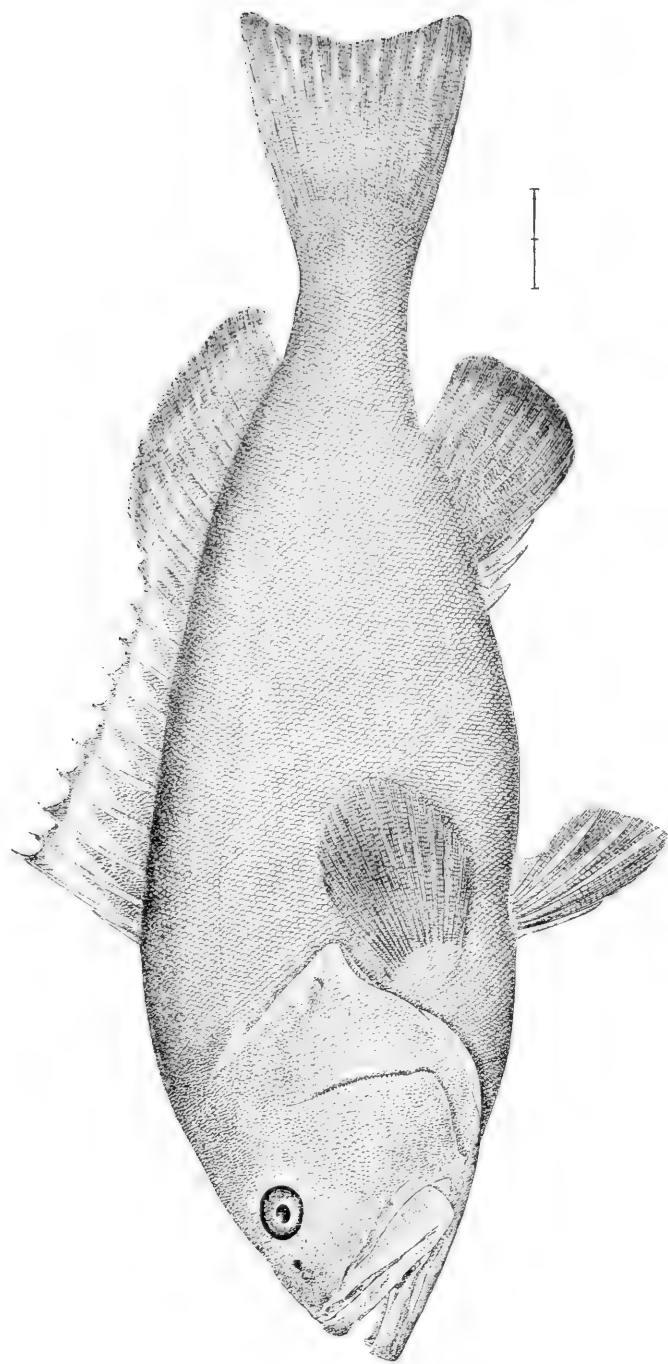
STRIPED BASS. *Roccus lineatus* (Bloch).





WHITE PERCH. *Morone americana* (Gmelin).

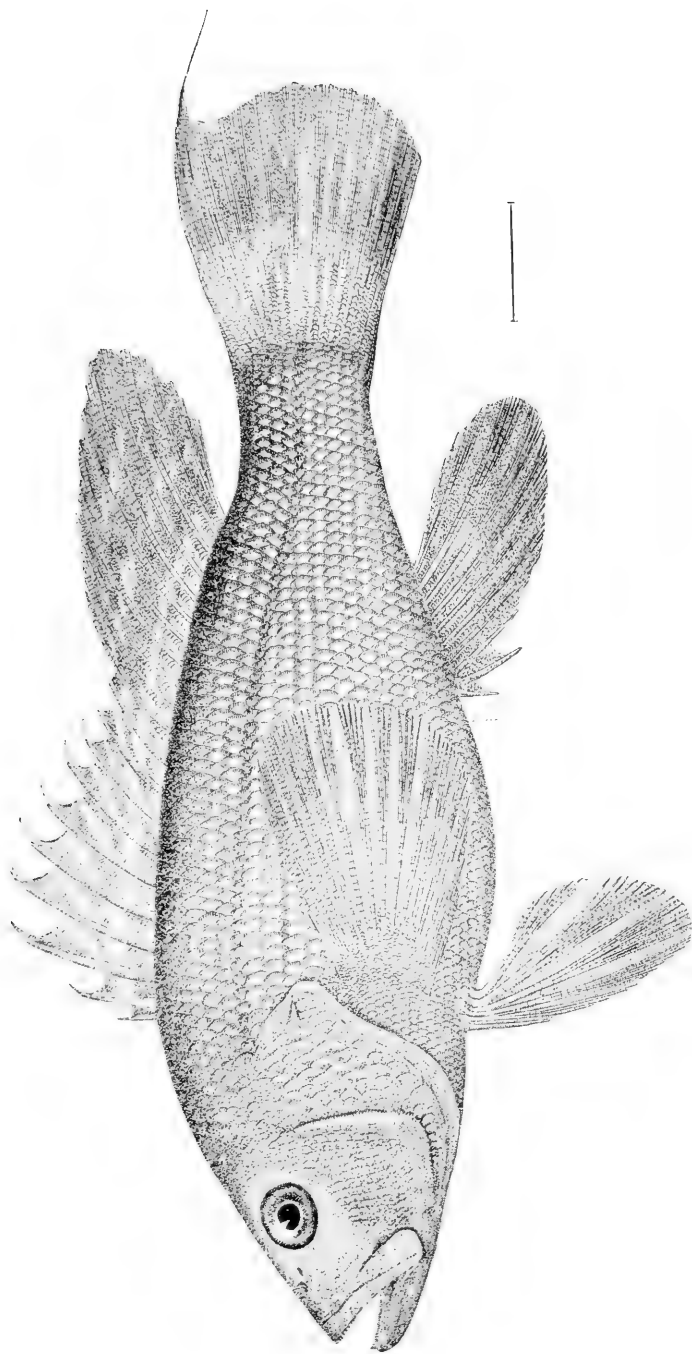




GROUPE. *Epinephelus morio* (Valenciennes).

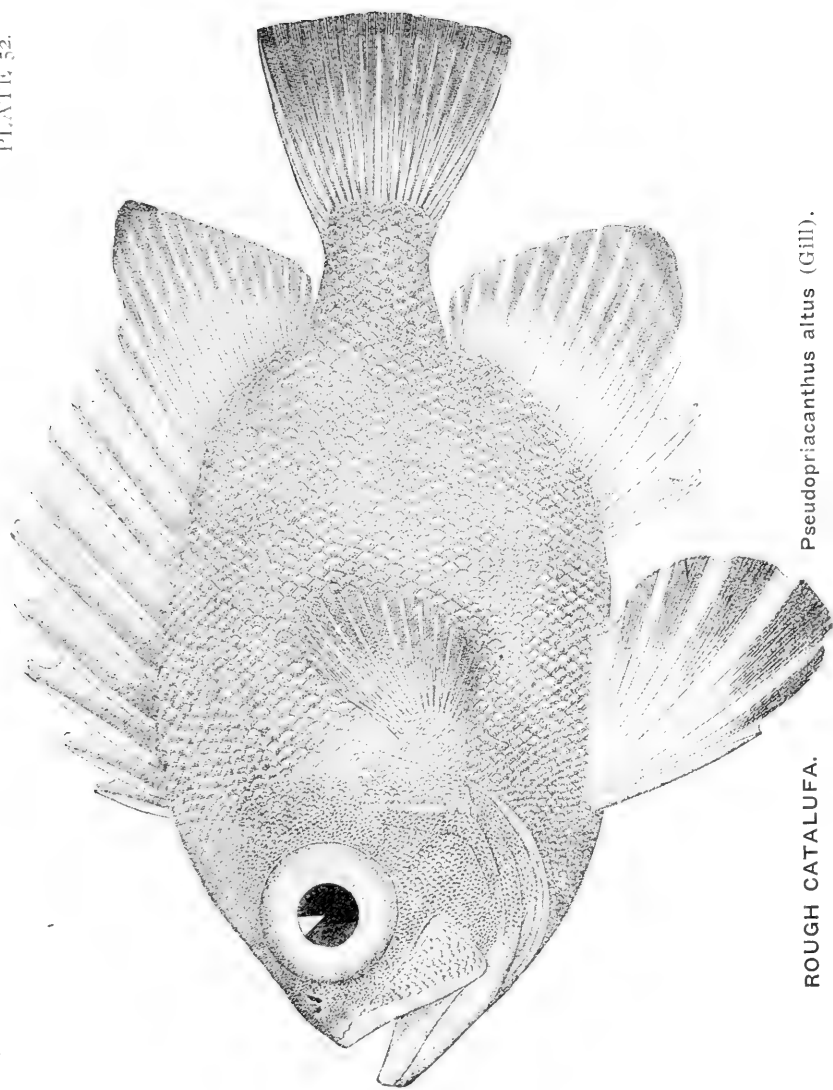






BLACK SEA BASS. *Centropristes striatus* (Linnaeus).

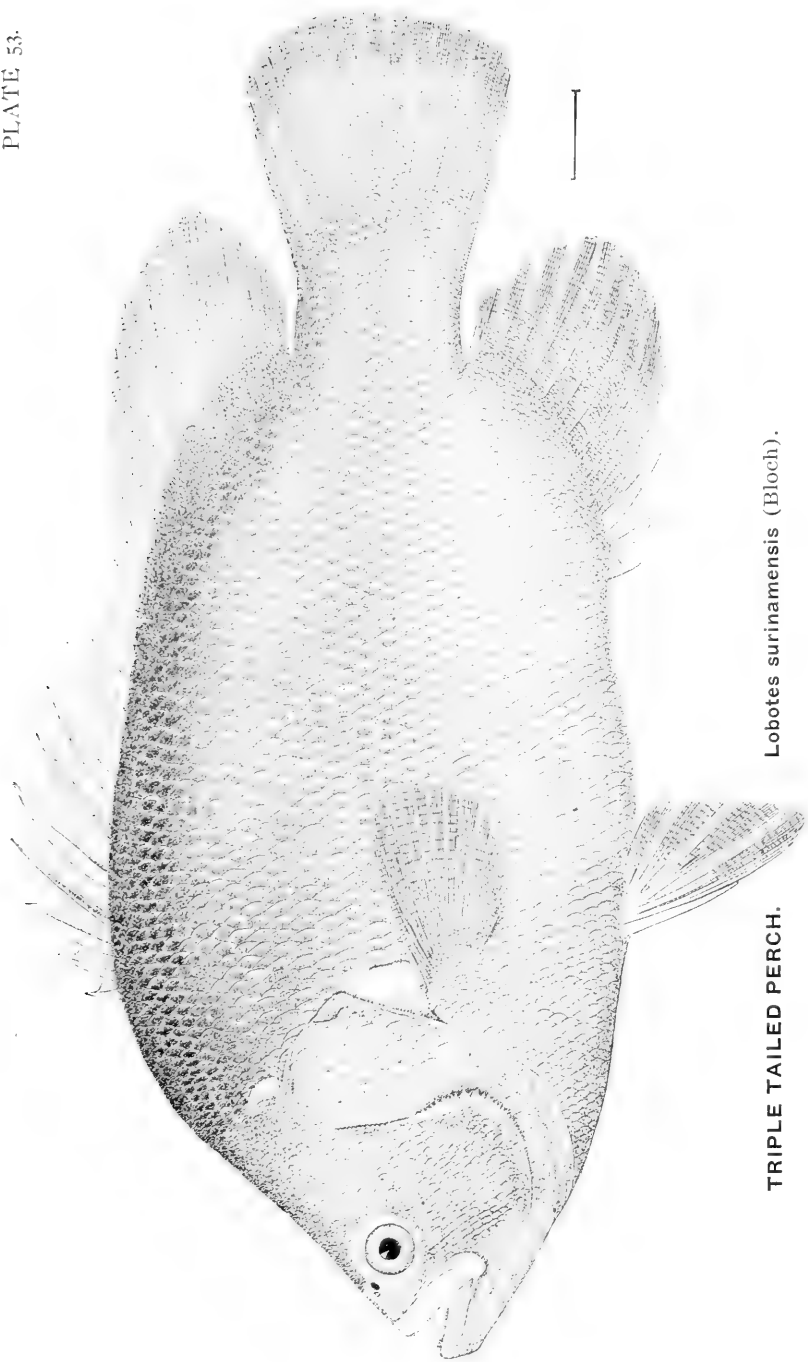




ROUGH CATALUFA.

*Pseudopriacanthus altus* (Gill).

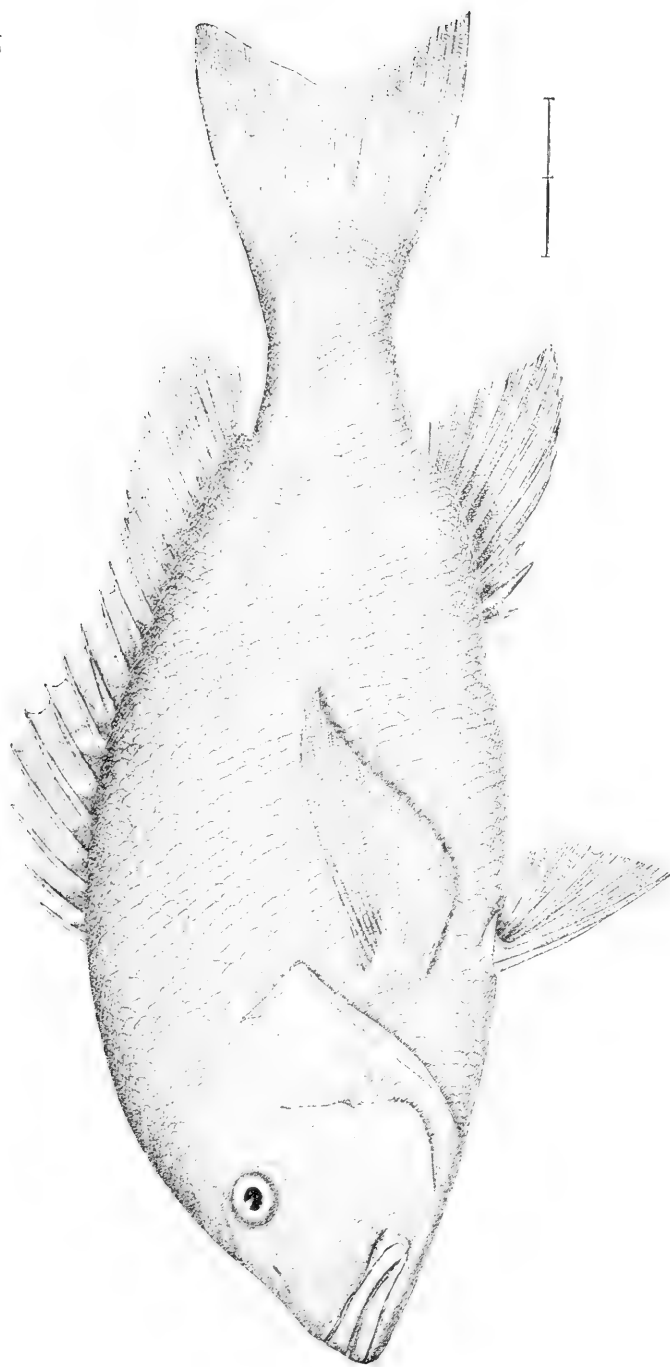




*Lobotes surinamensis* (Bloch).

TRIPLE TAILED PERCH.

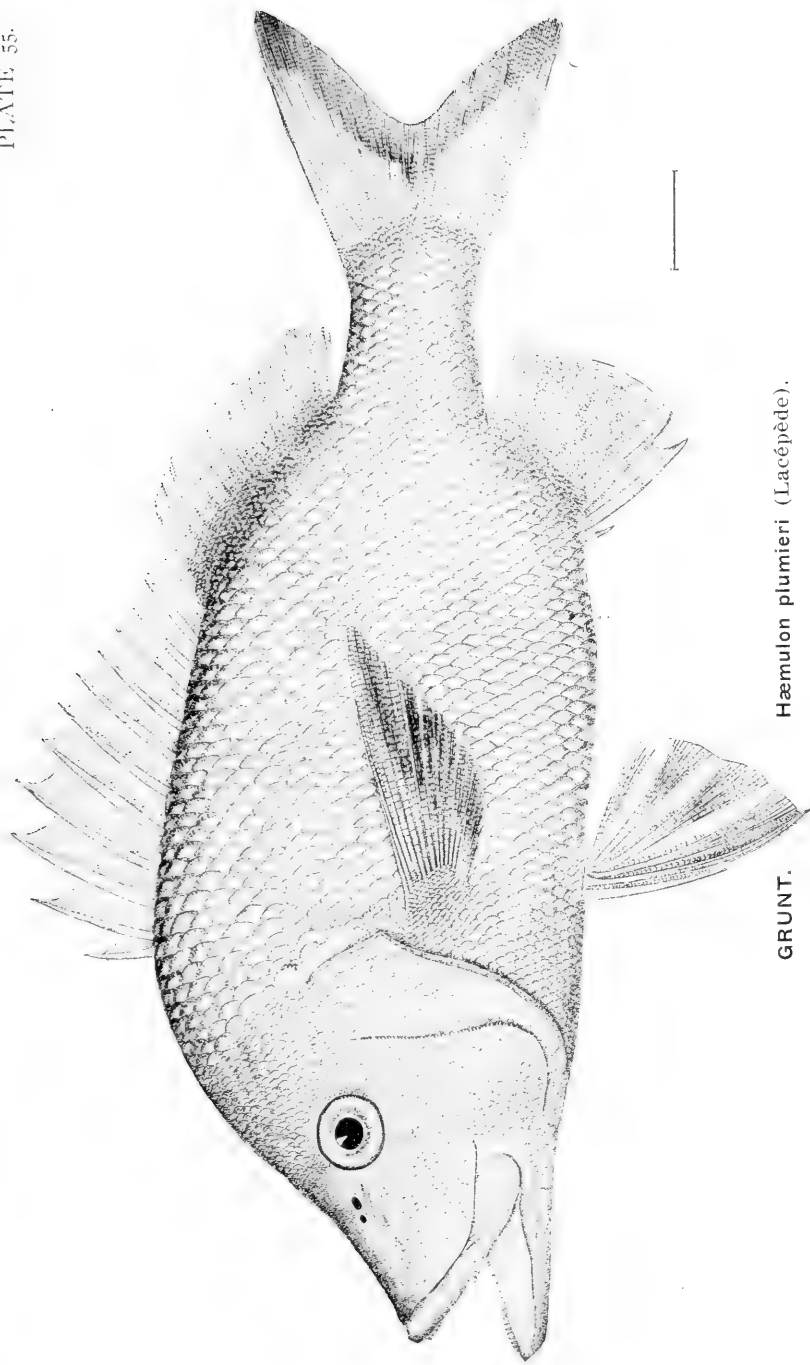




RED SNAPPER. *Lutianus blackfordii* (Goode and Bean).



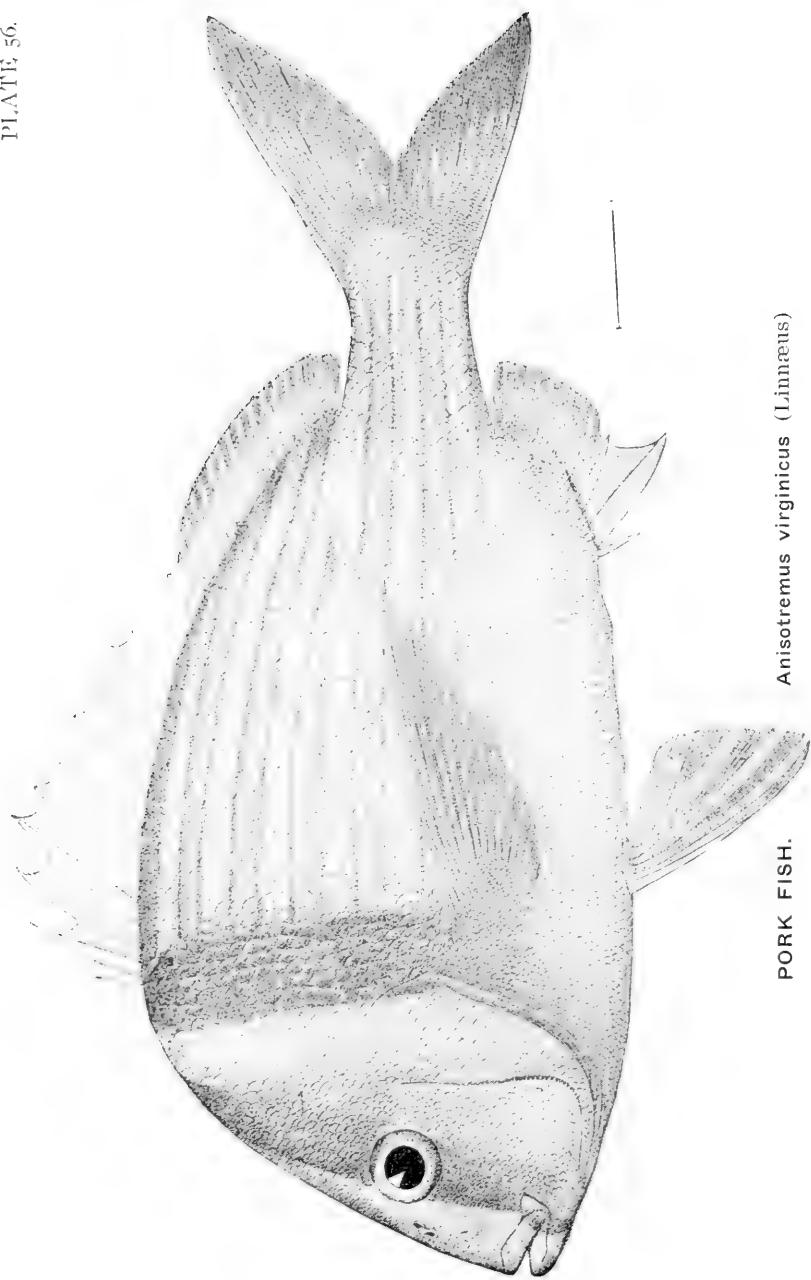




GRUNT.

*Haemulon plumieri* (Lacépède).

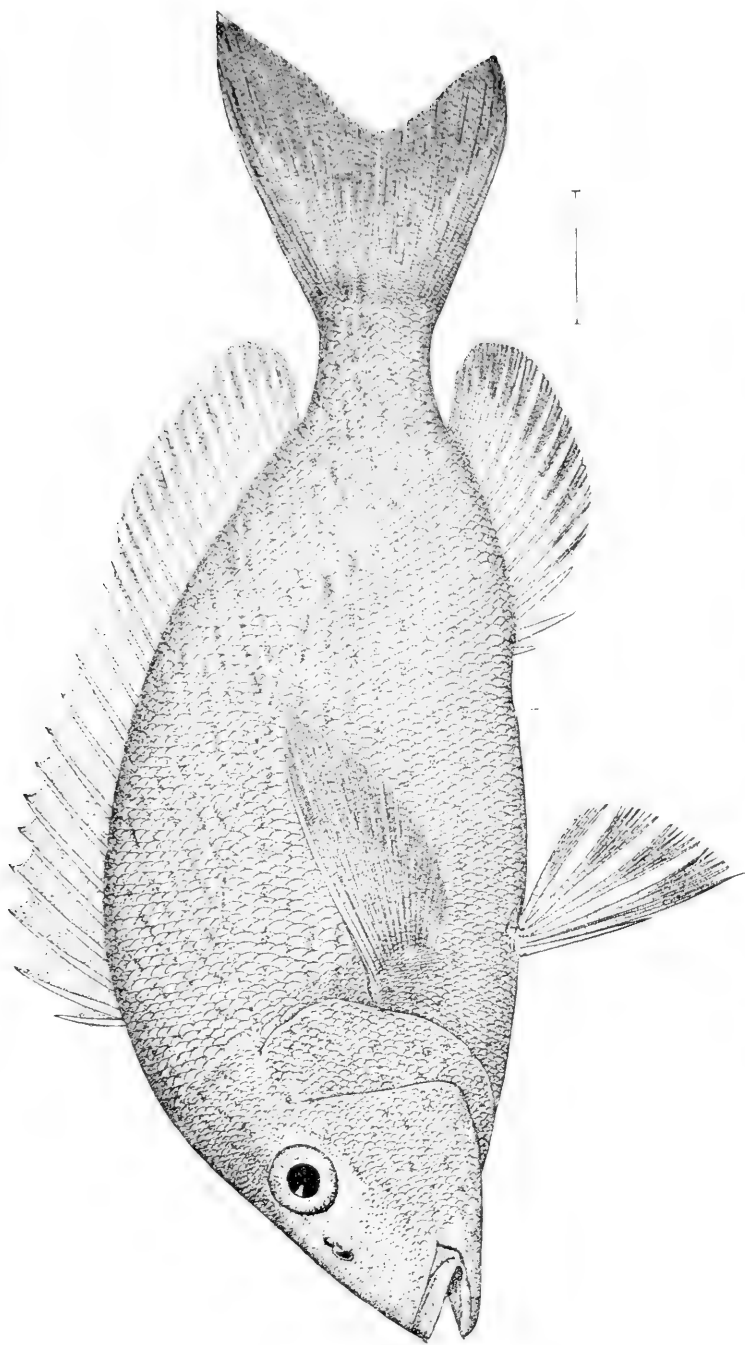




PORK FISH.

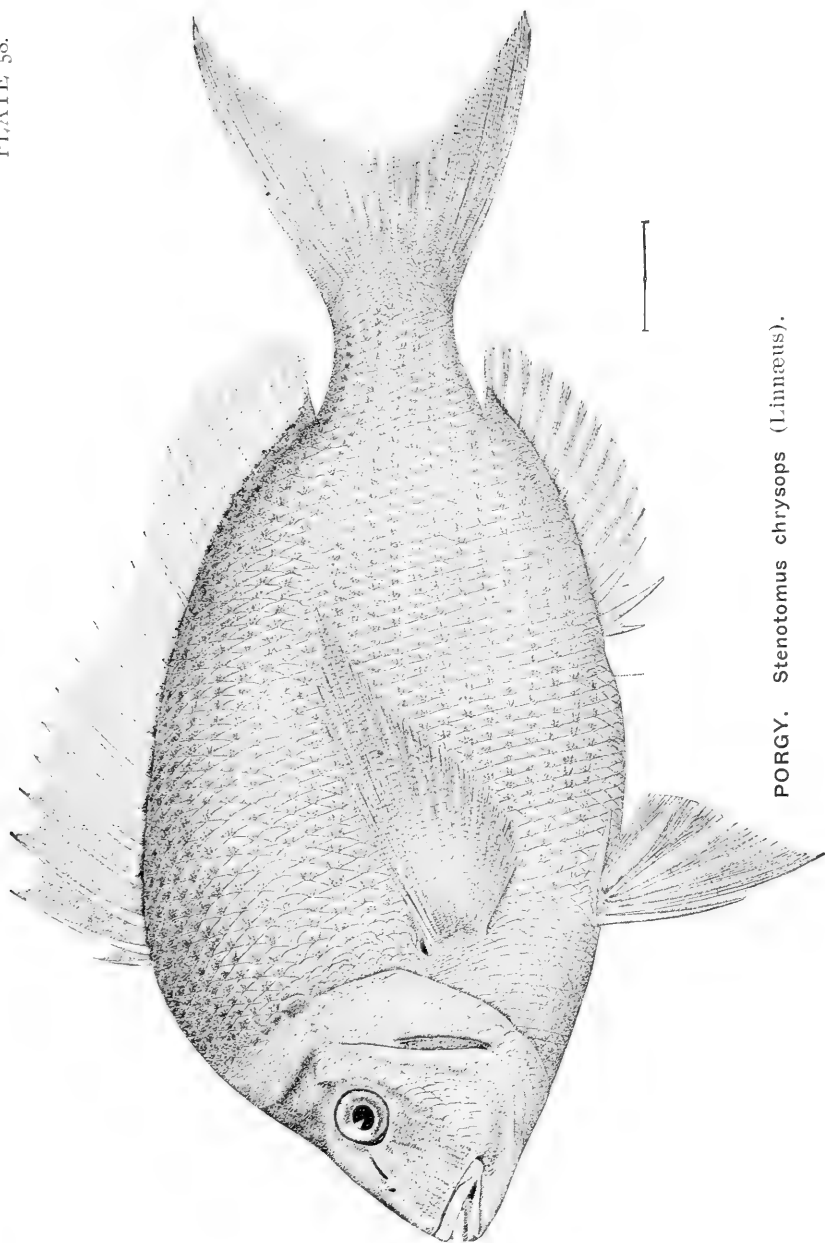
*Anisotremus virginicus* (Linnaeus)





SPECKLED RED MOUTH. *Orthopristis chrysopterus* (Linnæus).

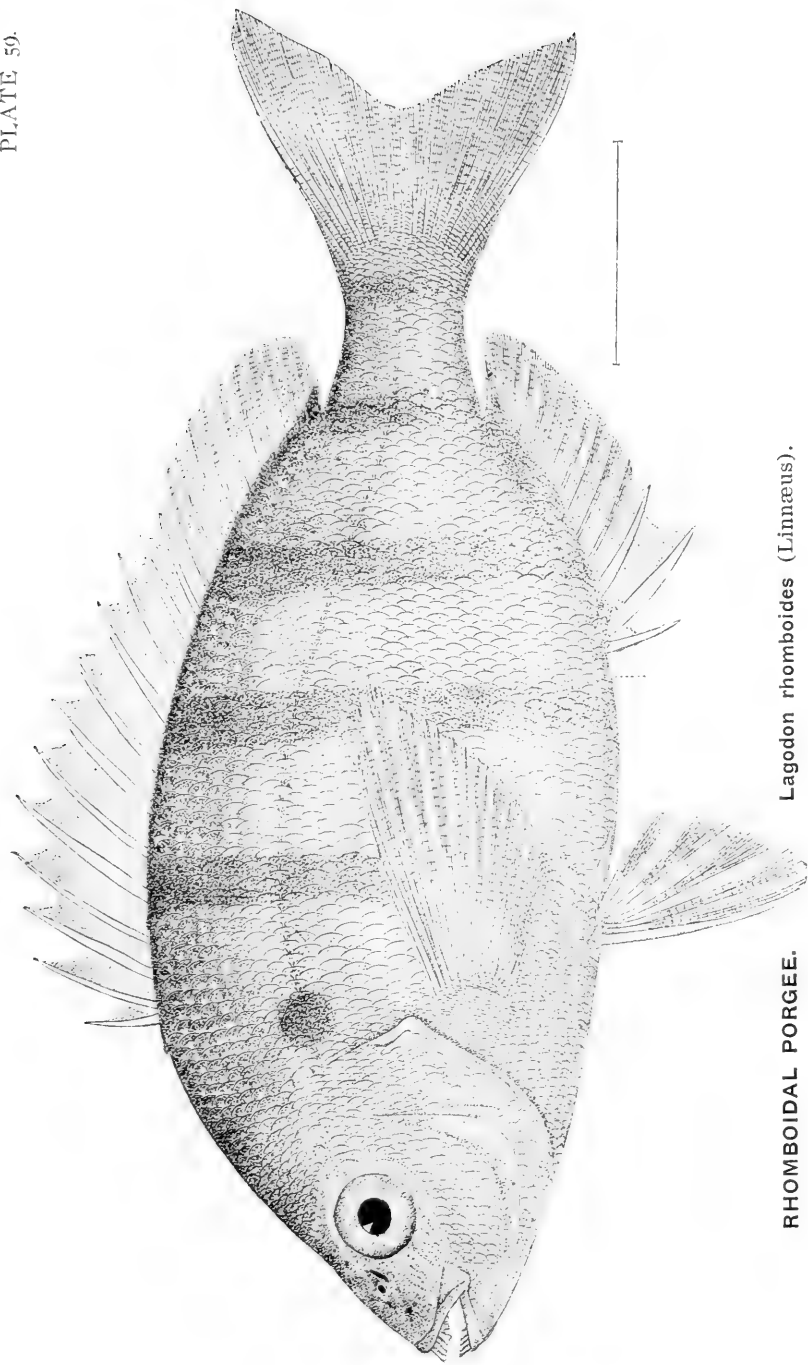




PORGY. *Stenotomus chrysops* (Linnaeus).



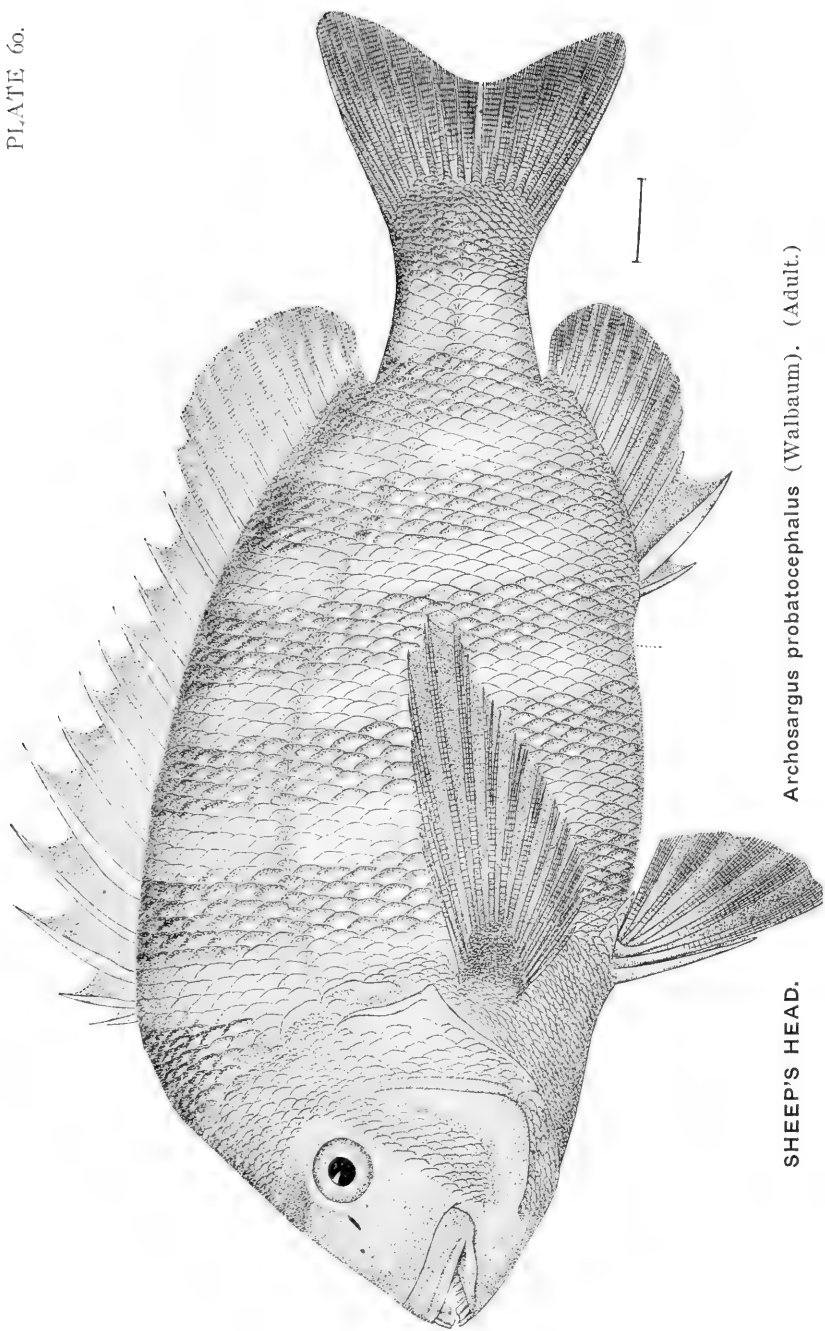




**RHOMBOIDAL PORGEE.**

**Lagodon rhomboides (Linnaeus).**

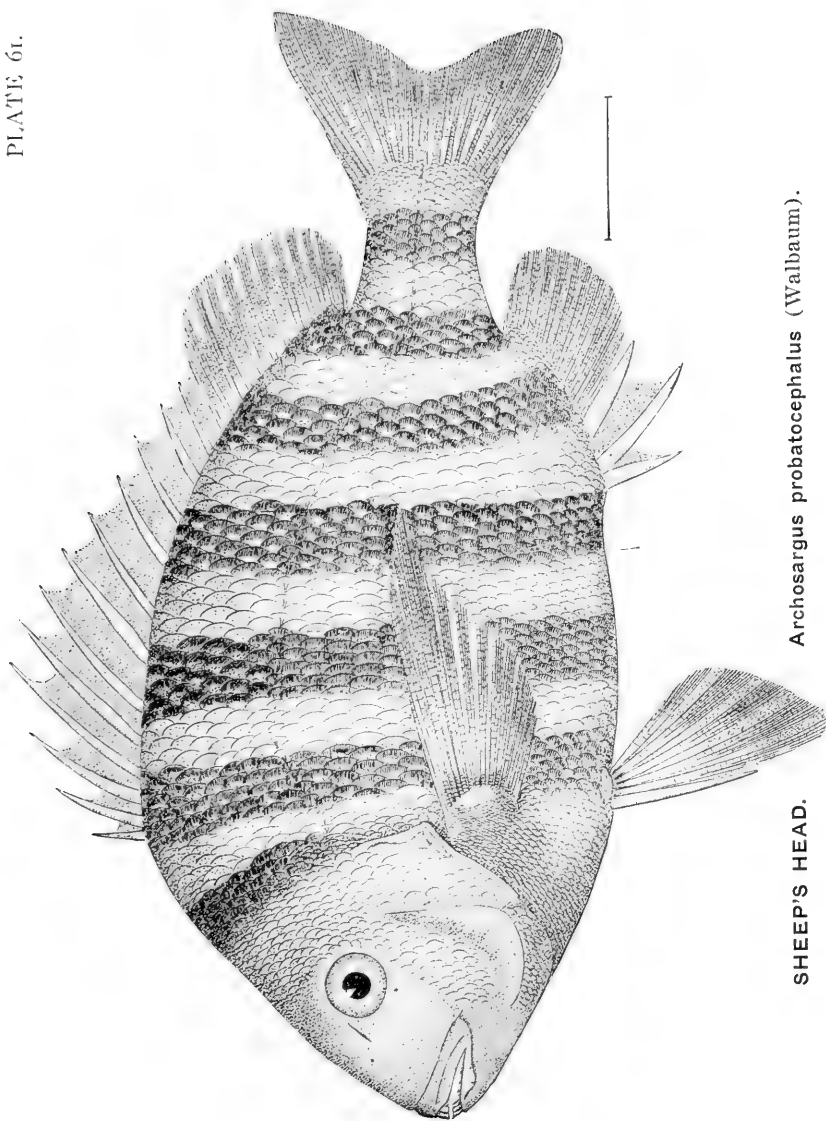




SHEEP'S HEAD.

*Archosargus probatocephalus* (Walbaum). (Adult.)

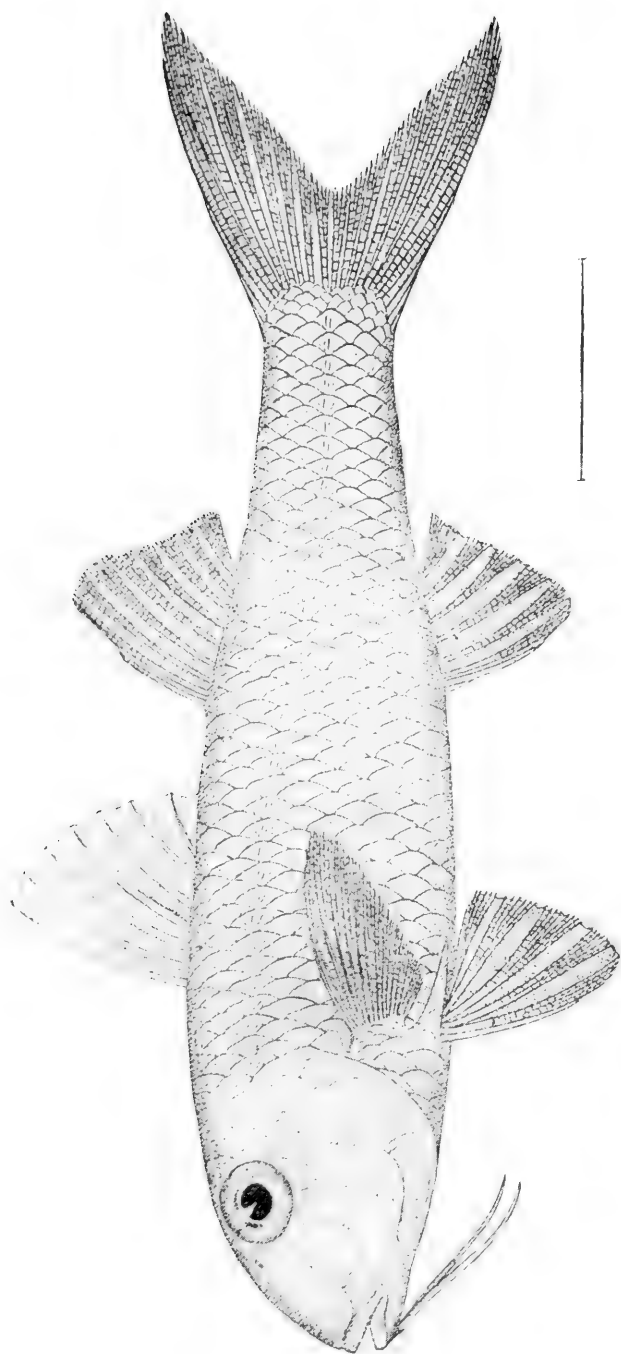




*Archosargus probatocephalus* (Walbaum).

SHEEP'S HEAD.

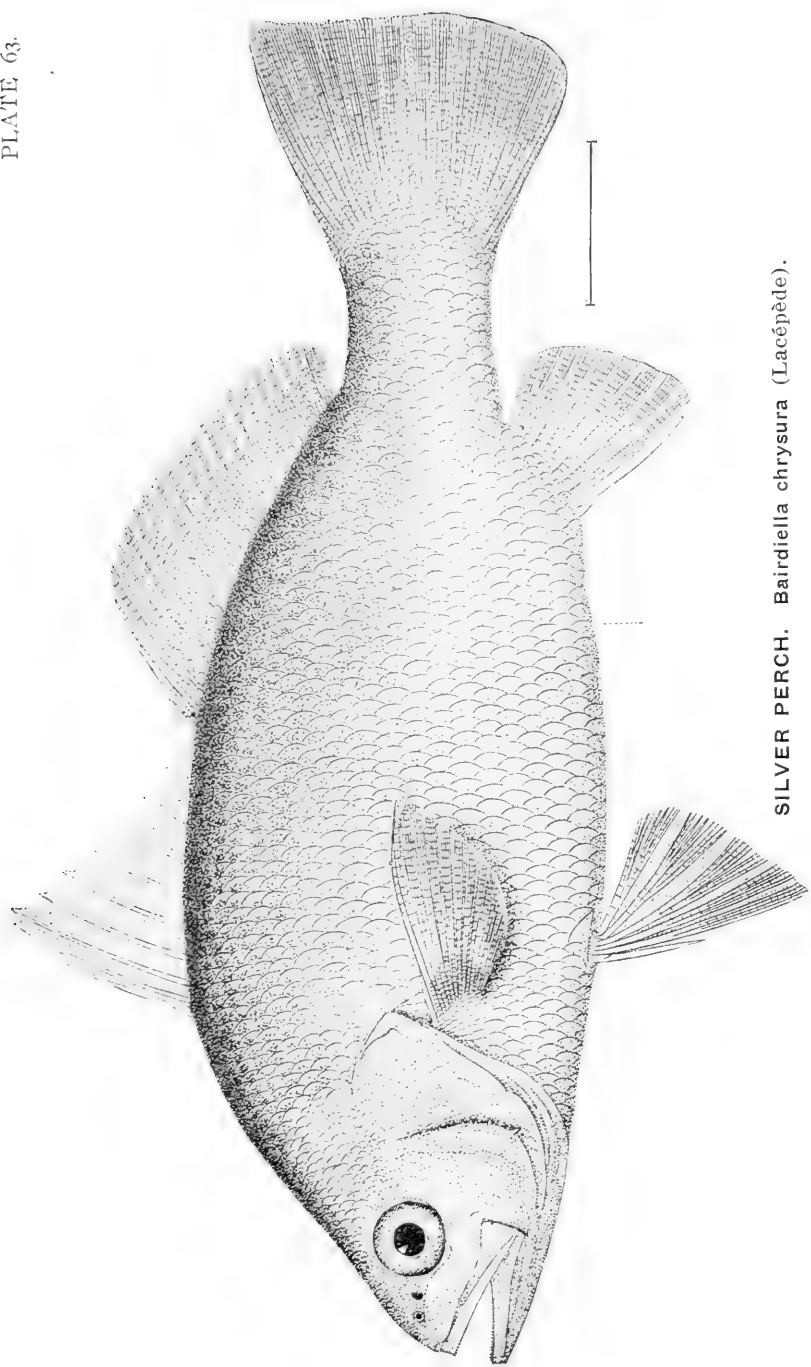




GOAT FISH. *Mullus auratus* (Jordan and Gilbert).

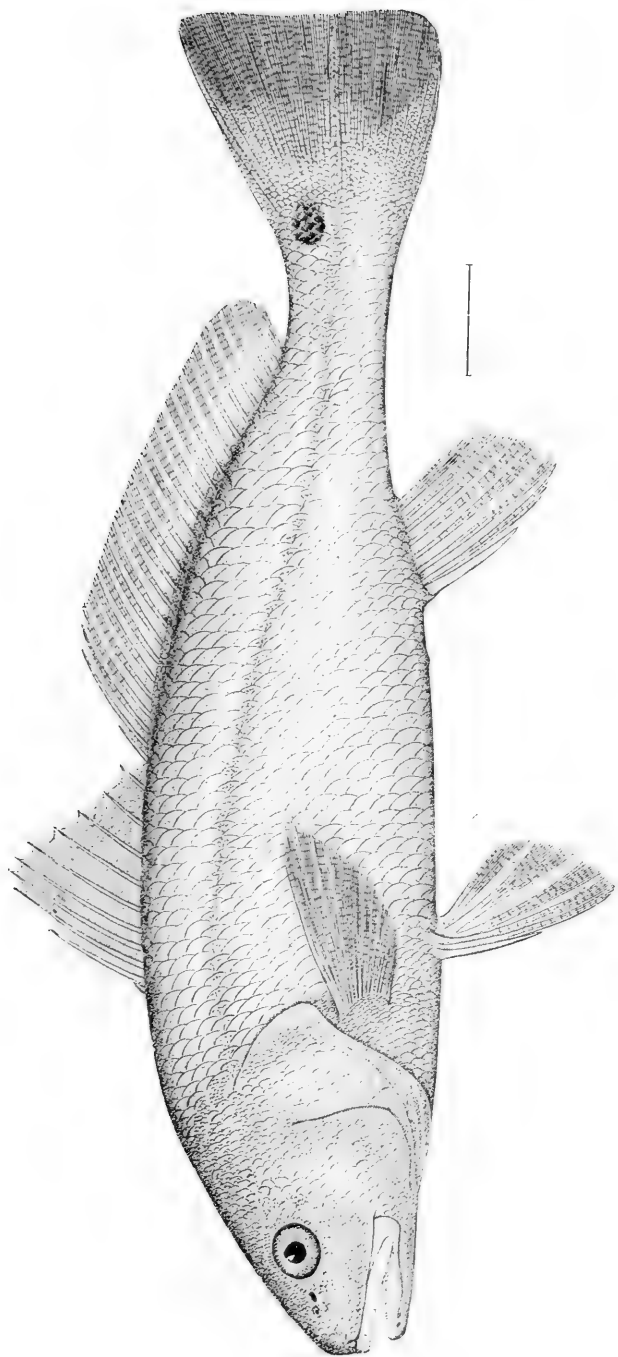






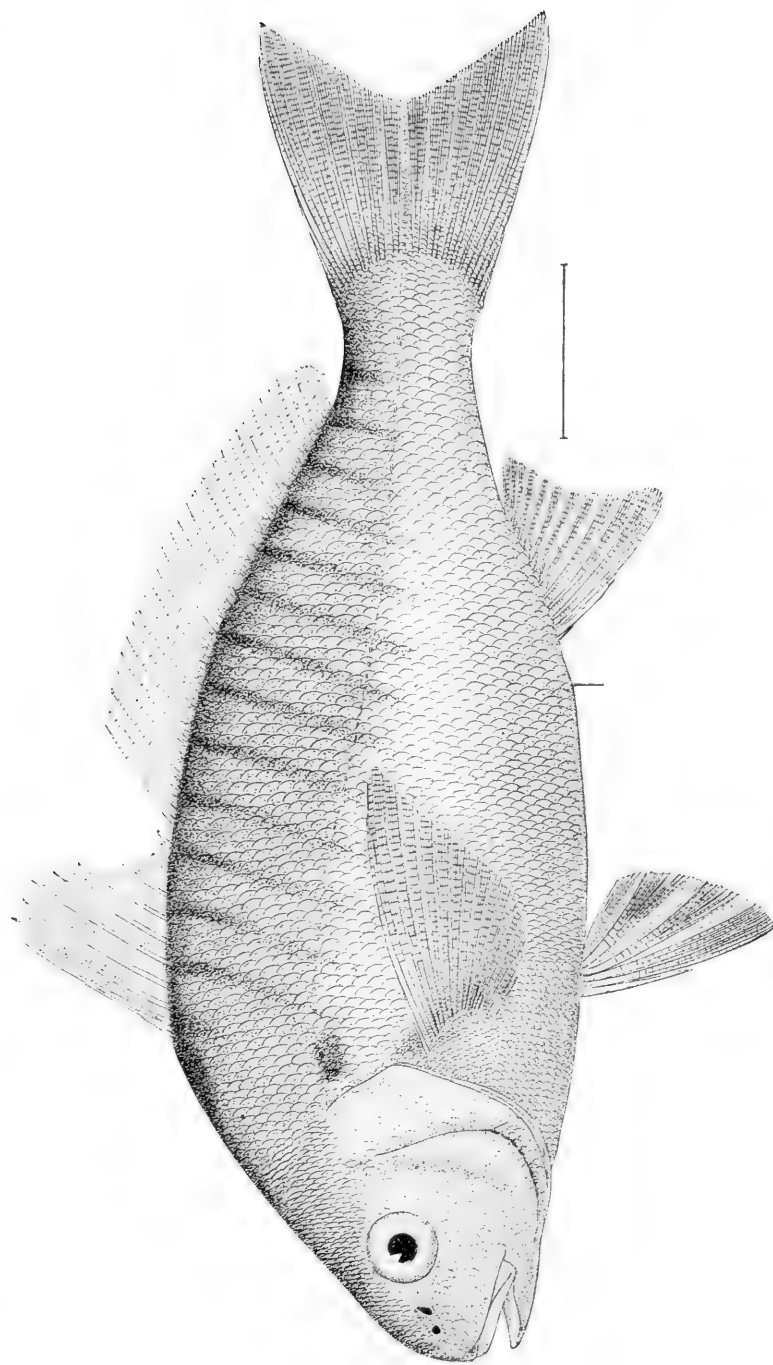
SILVER PERCH. *Bairdiella chrysura* (Lacépède).





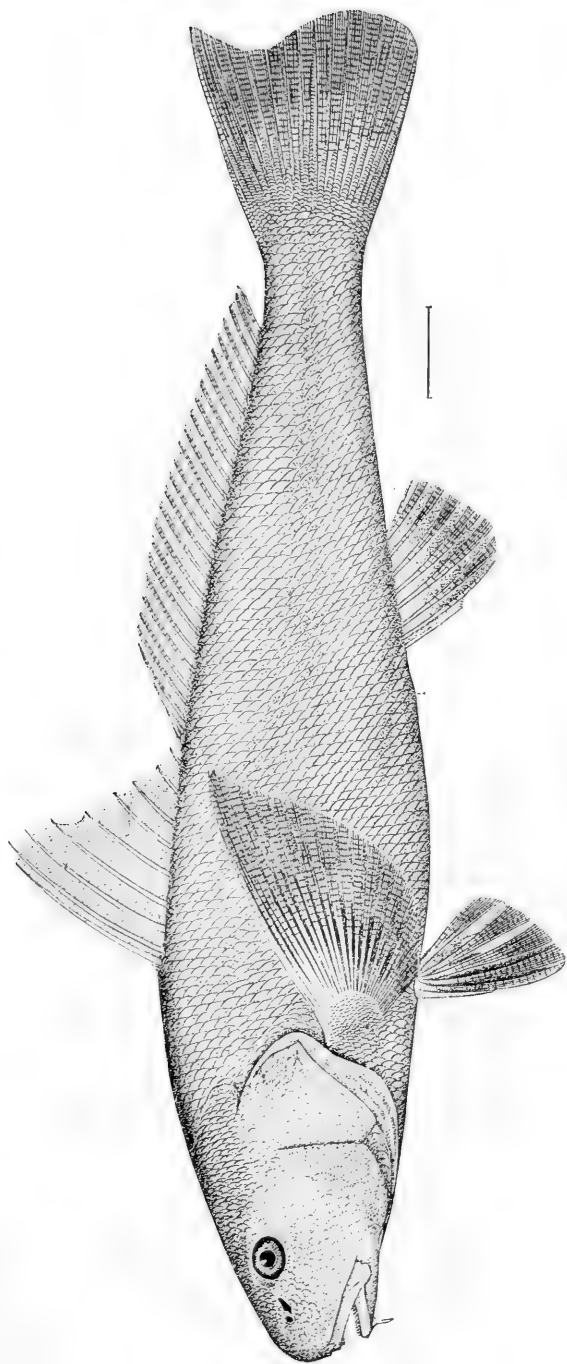
RED DRUM. *Sciaenops ocellatus* (Linnaeus).





GOODY. *Leiostomus xanthurus* Lacépède.

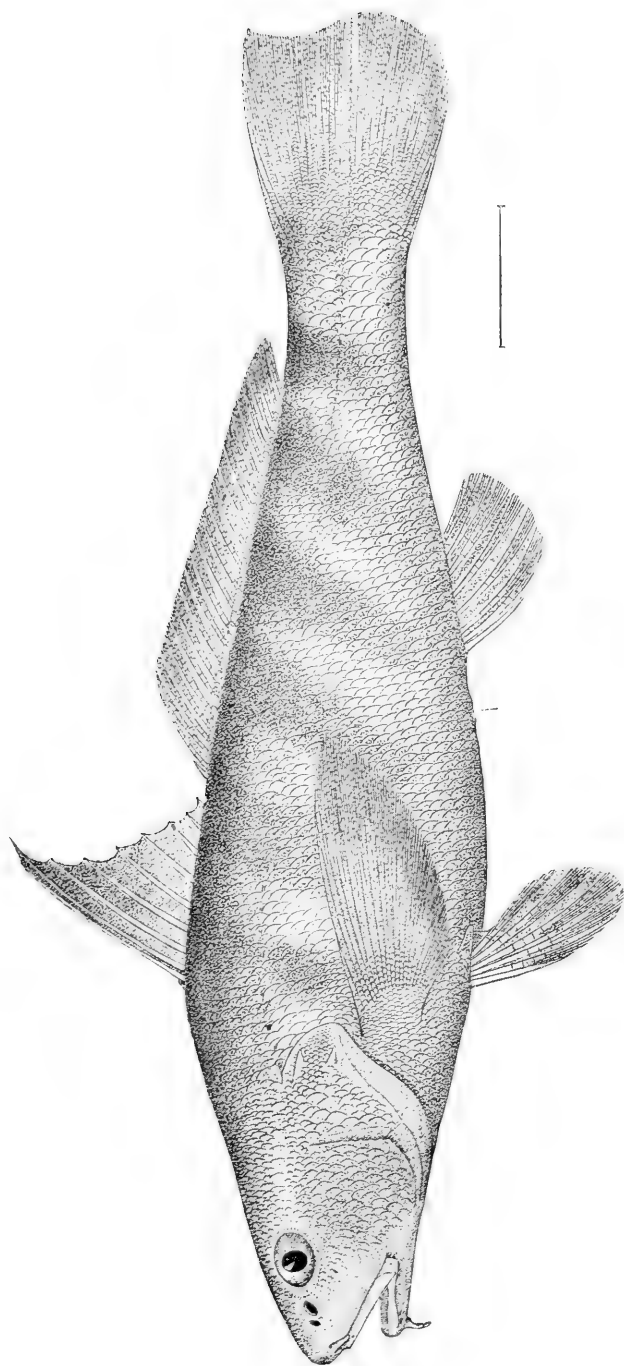




KING FISH. *Menticirrhus americanus* (Linnæus).

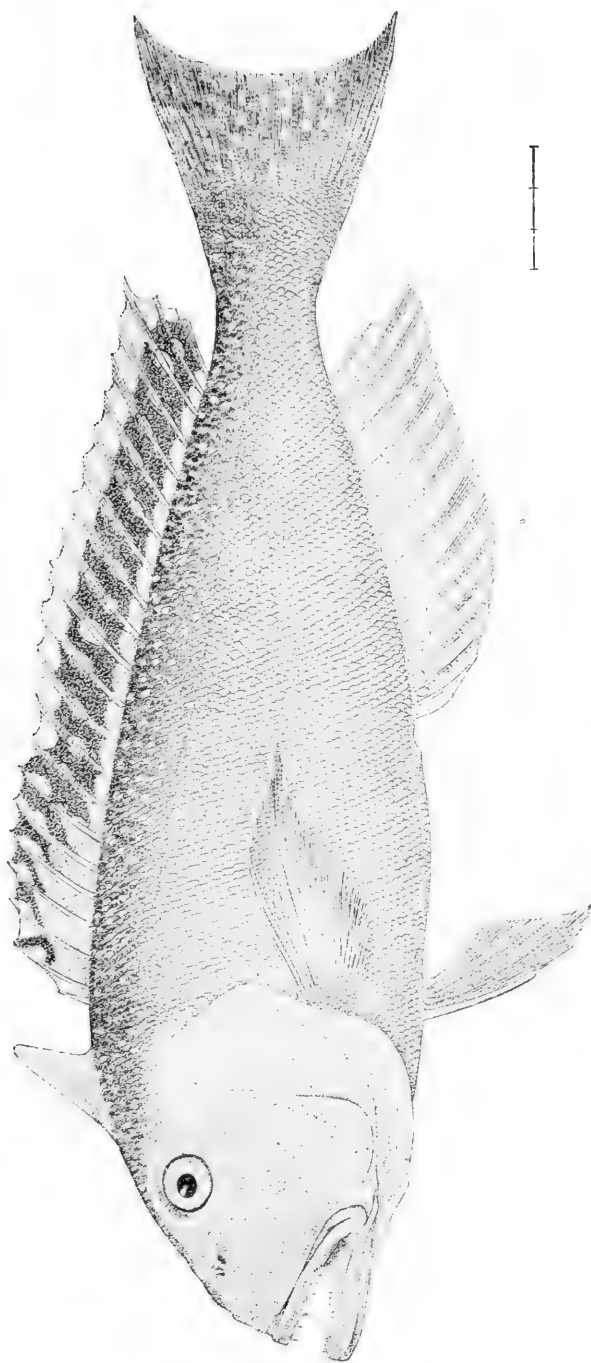






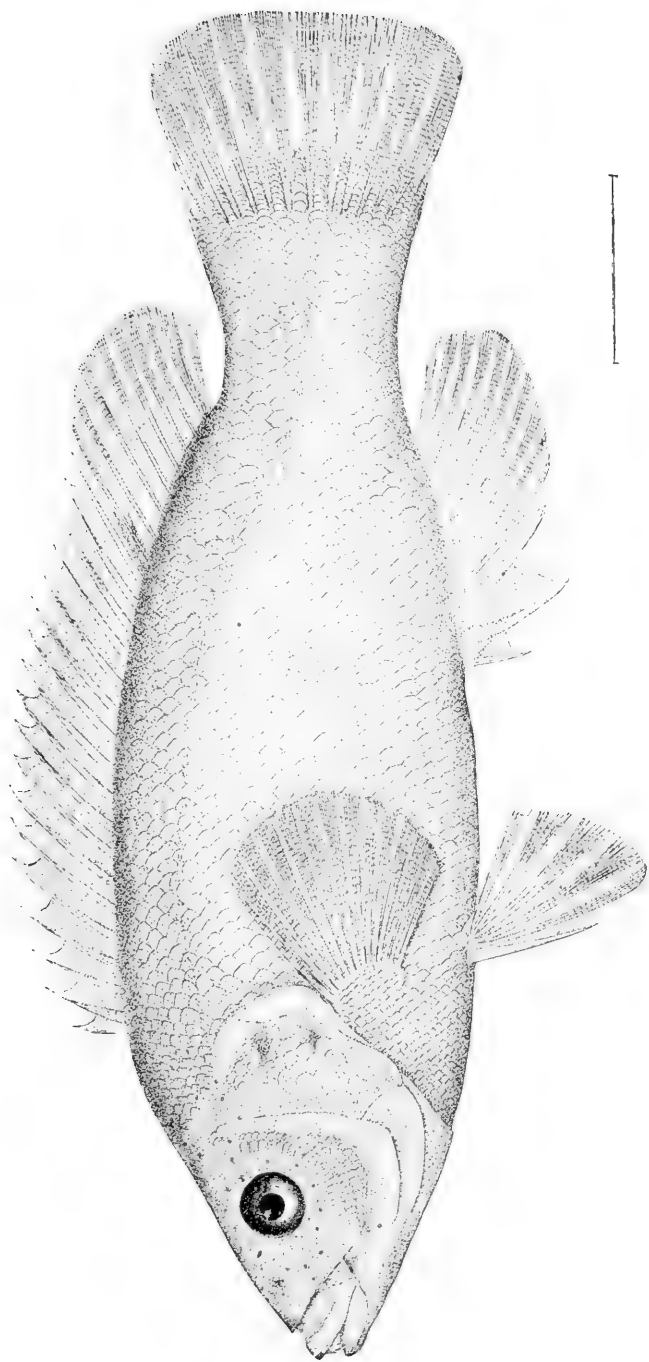
BARB. *Menticirrhus saxatilis* (Schneider).





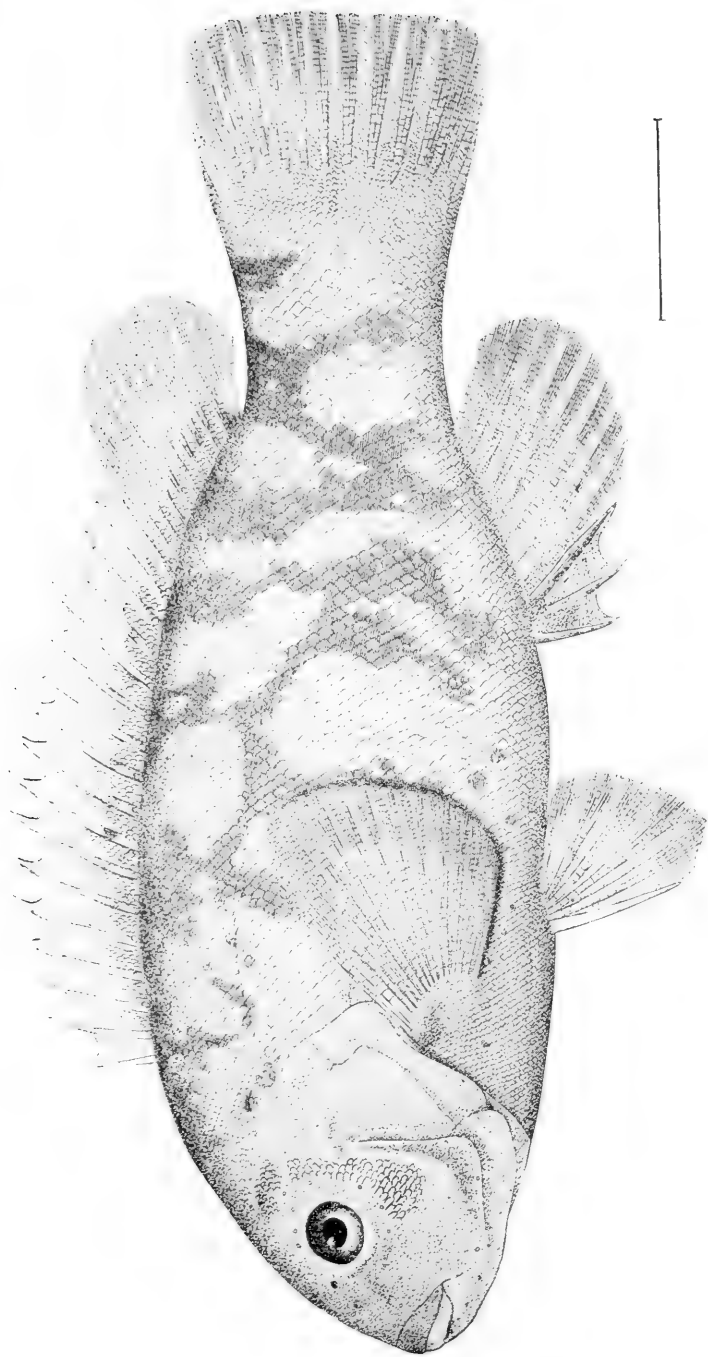
TILE FISH. *Lopholatilus chamaeleonticeps* Goode and Bean.





BERGALL. *Tautoglabrus adspersus* (Walbaum).

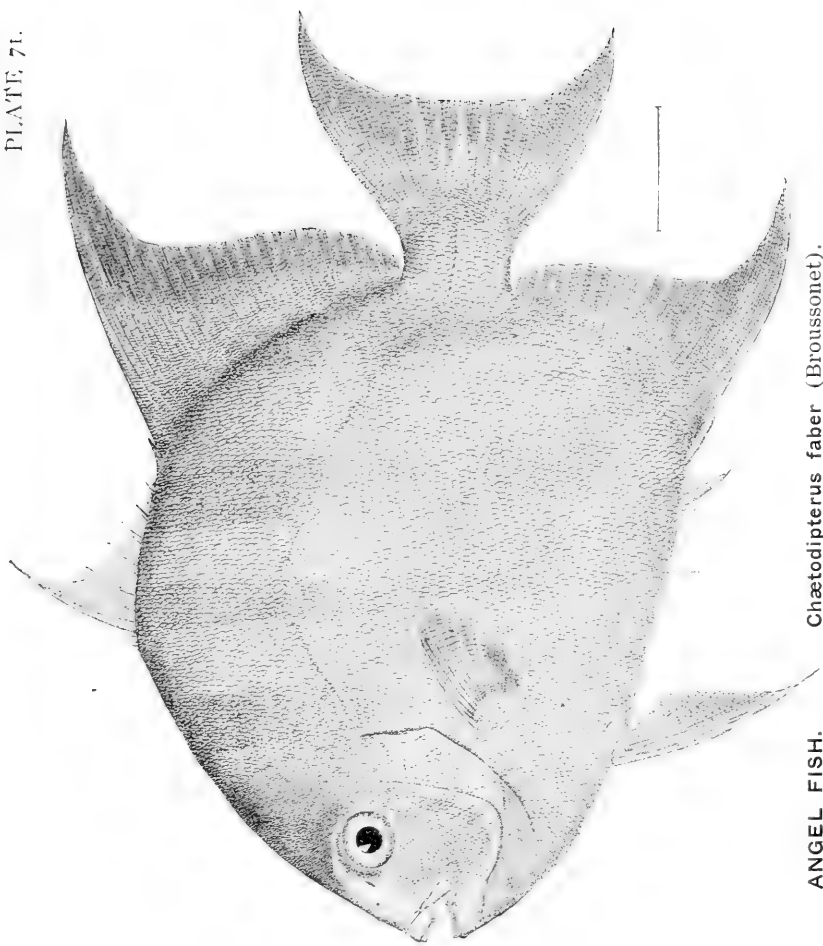




BLACK FISH. *Tautoga onitis* (Linnæus).

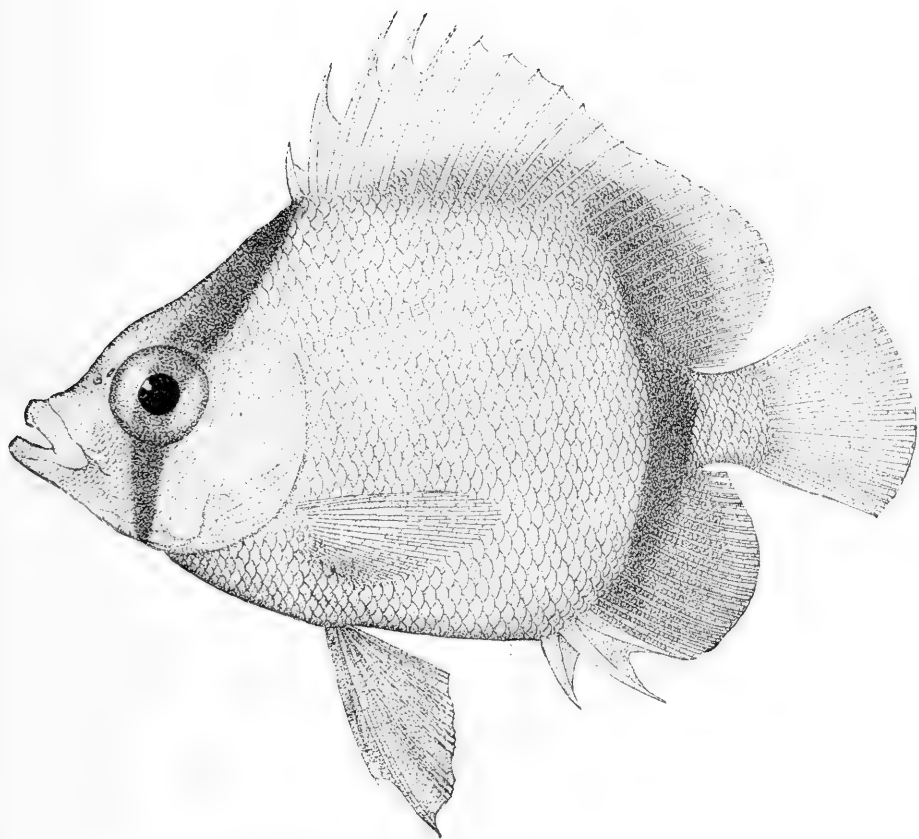






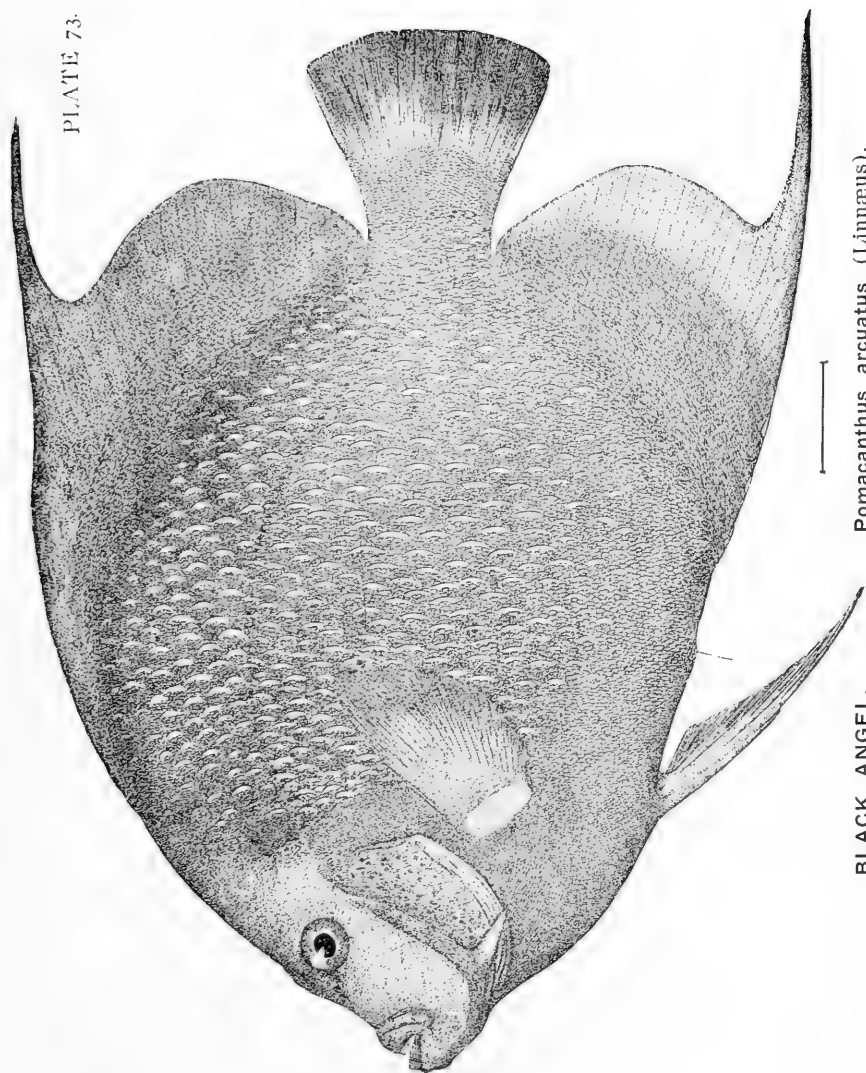
ANGEL FISH. *Chaetodipterus faber* (Broussonet).





BUTTERFLY FISH. *Chætodon ocellatus* Bloch.

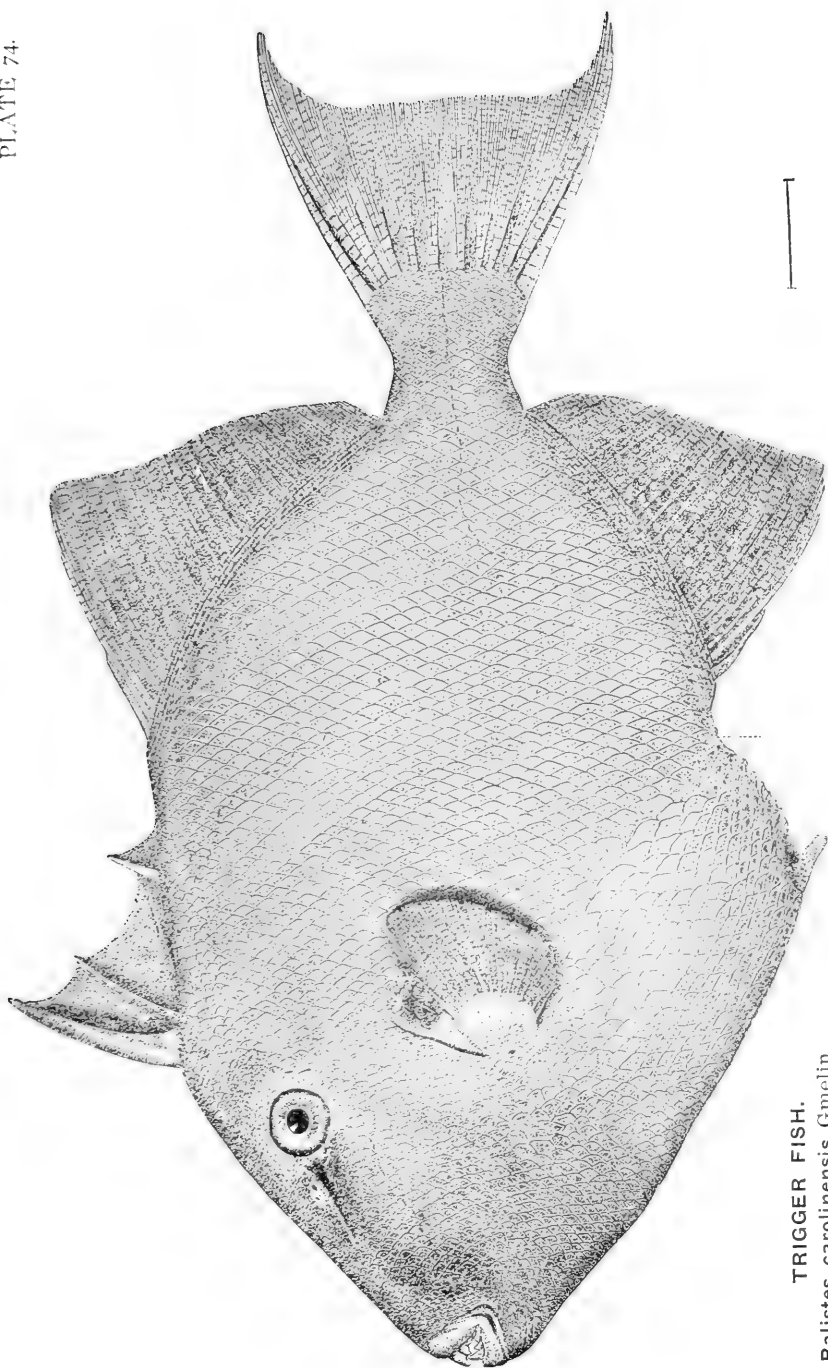




BLACK ANGEL.

*Pomacanthus arcuatus* (Linnæus).

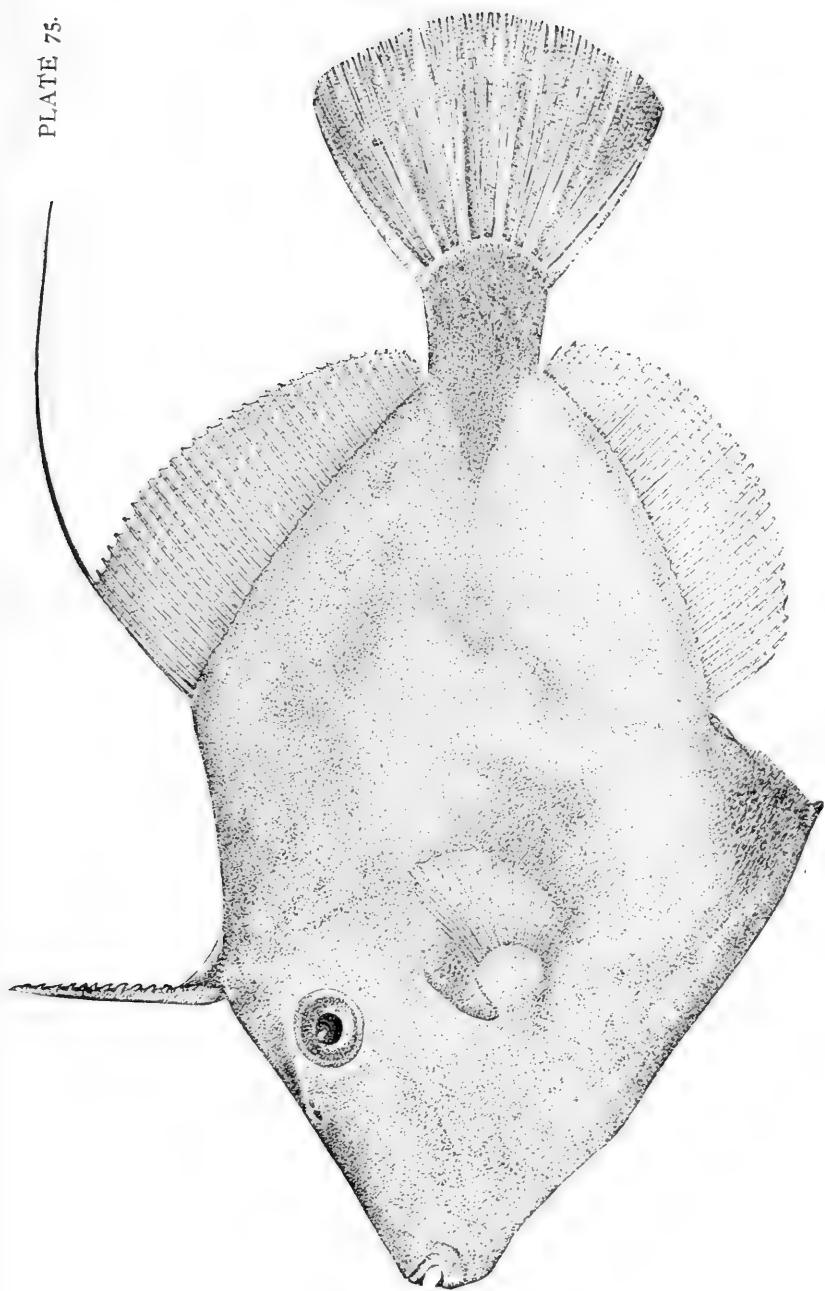




TRIGGER FISH.  
*Balistes carolinensis* Gmelin.

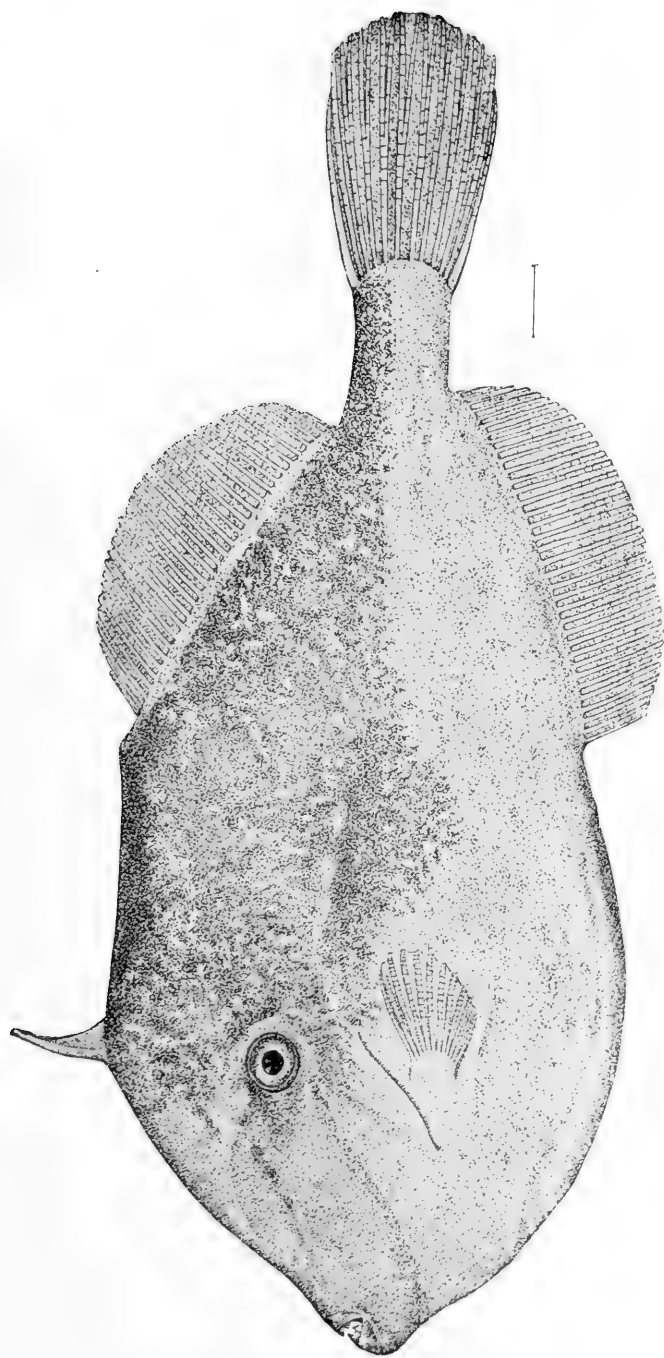






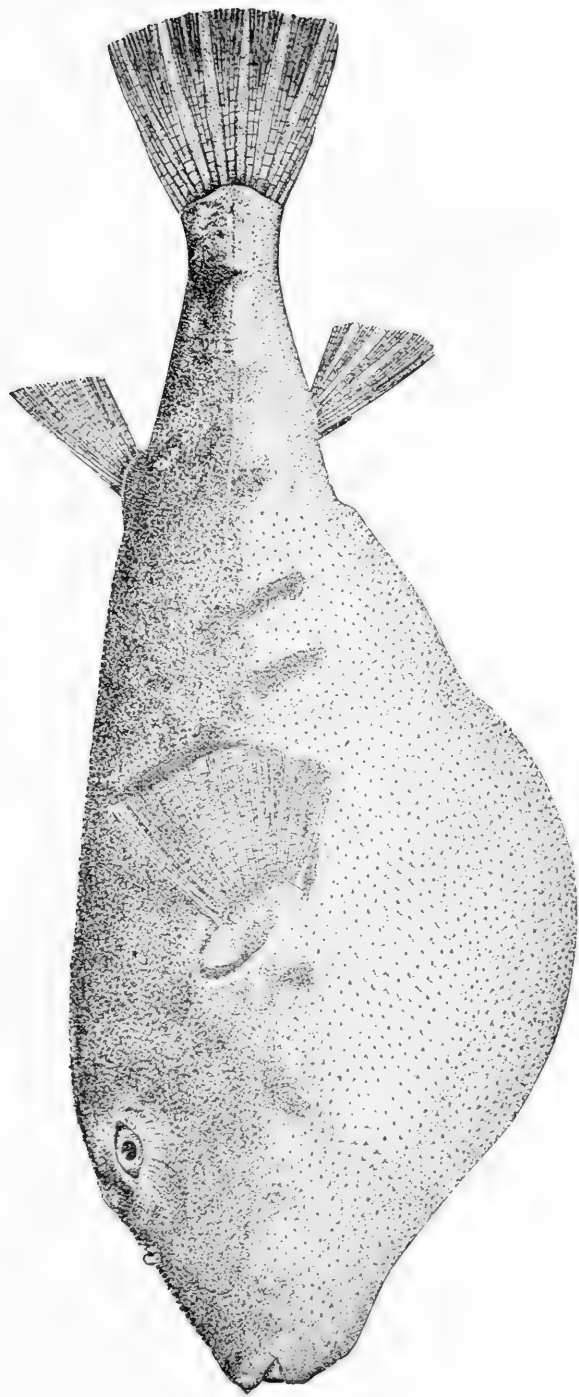
FOOL FISH. *Stephanolepis hispidus* (Linnaeus).





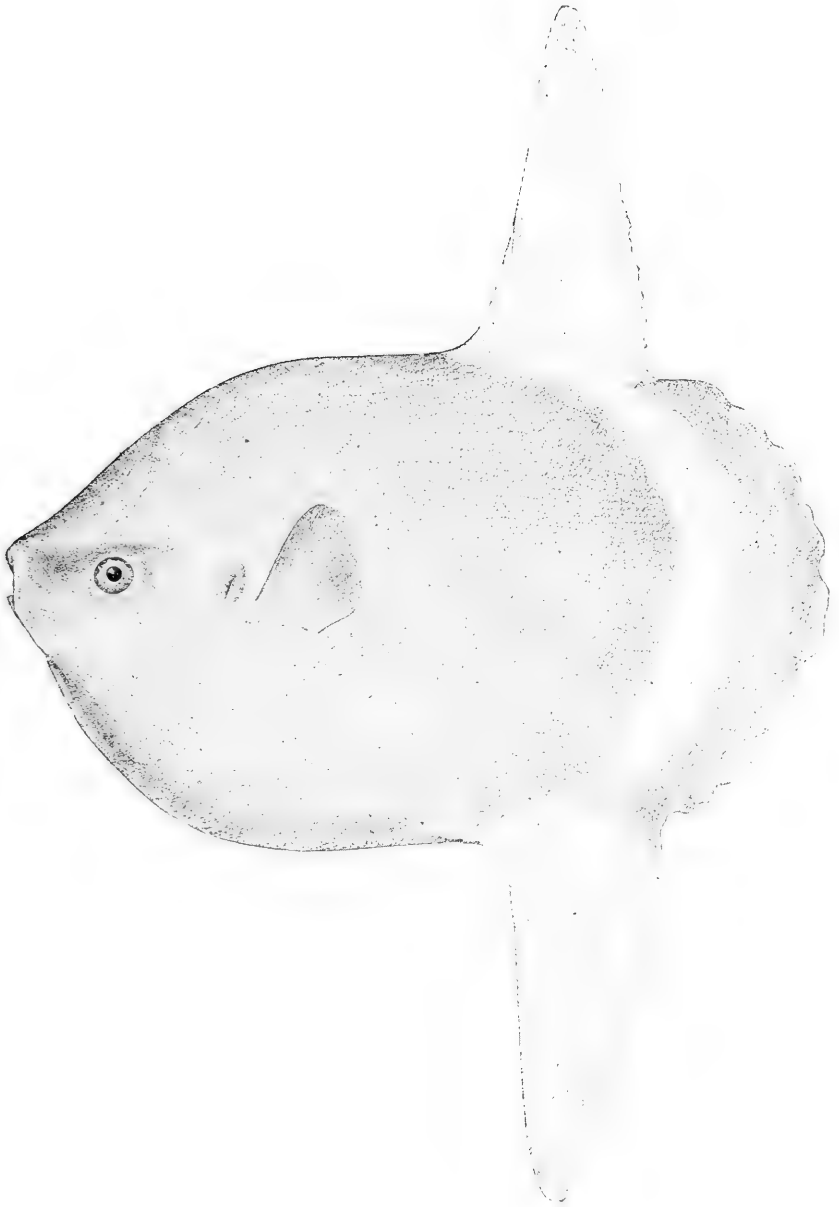
UNICORN FISH. *Alutera schoepfii* (Walbaum).





PUFFER. *Spheroides maculatus* (Schneider).

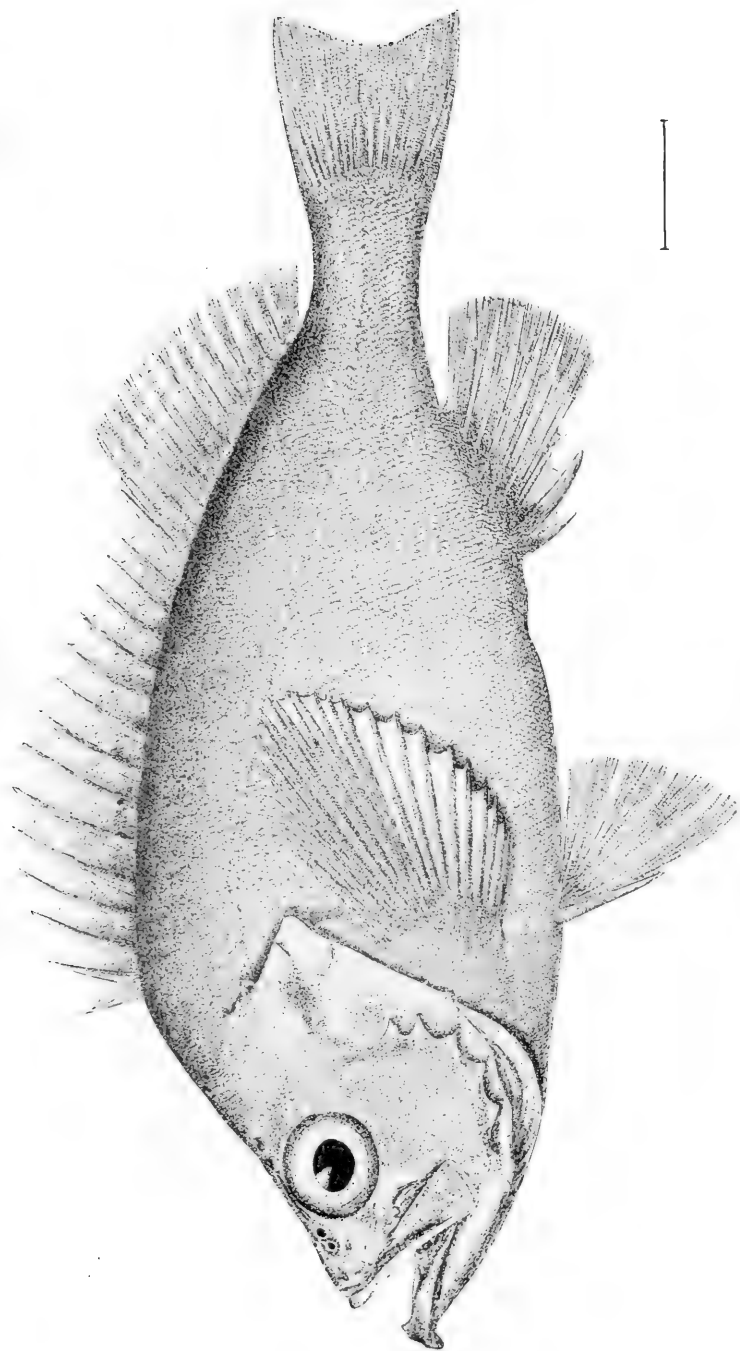




OCEAN SUN FISH. *Mola mola* (Linnæus).

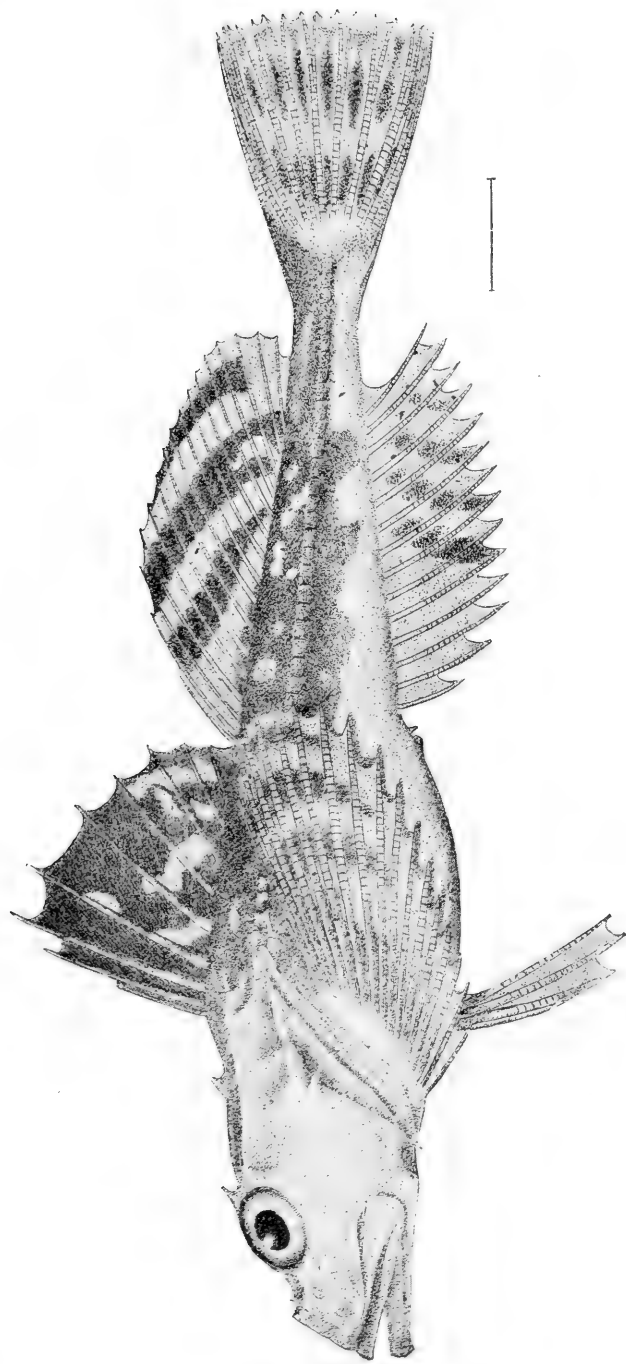






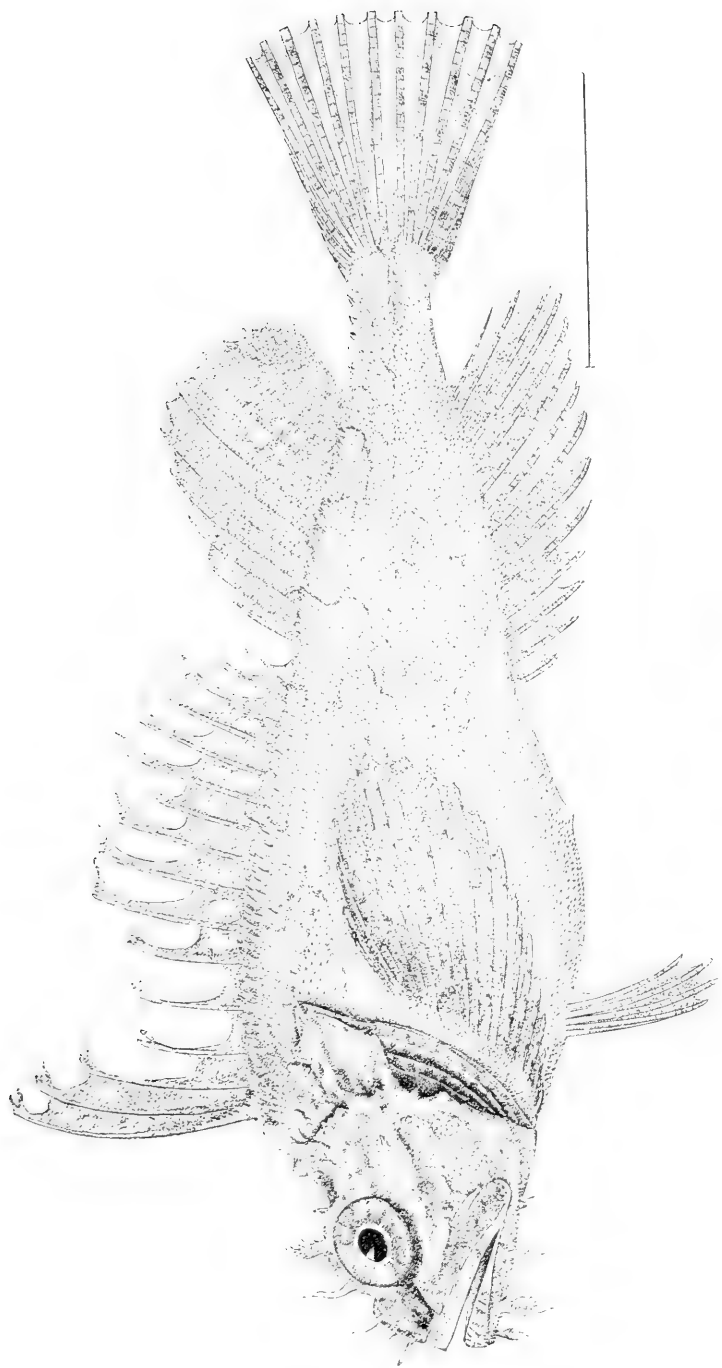
RED SEA PERCH. *Sebastes marinus* (Linnæus).



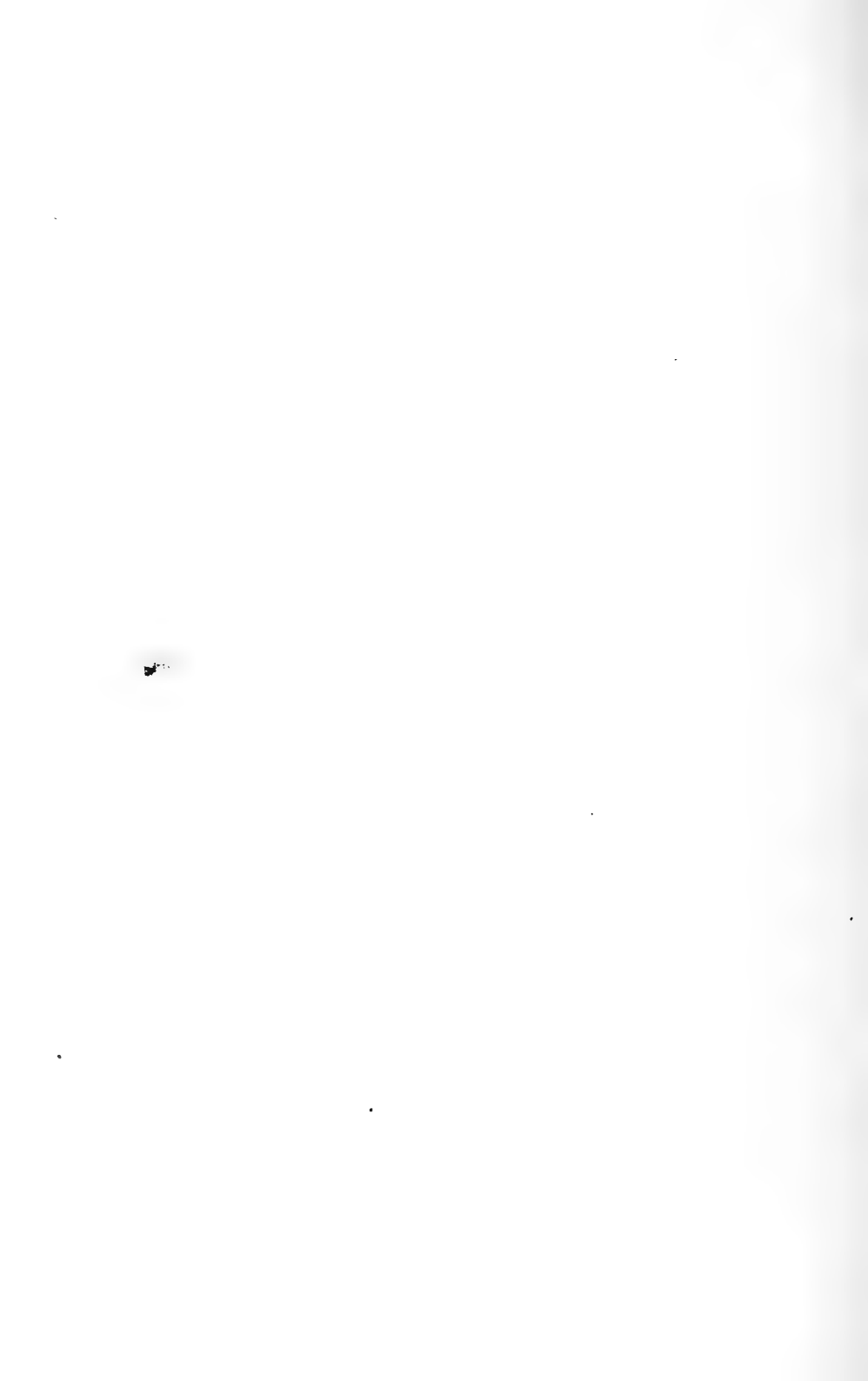


SCULPIN. *Myoxocephalus octodecimspinosus* (Mitchill).





SEA RAVEN. *Hemitripterus americanus* (Gmelin).

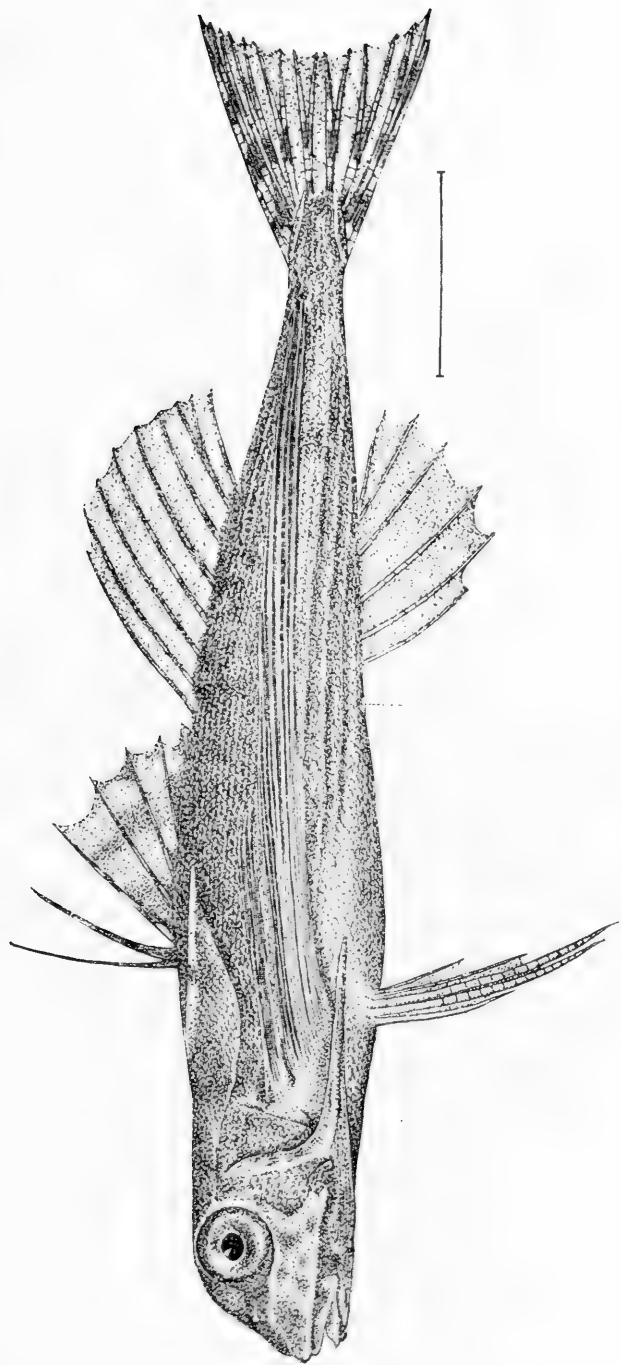




LUMP FISH. *Cyclopterus lumpus* Linnaeus

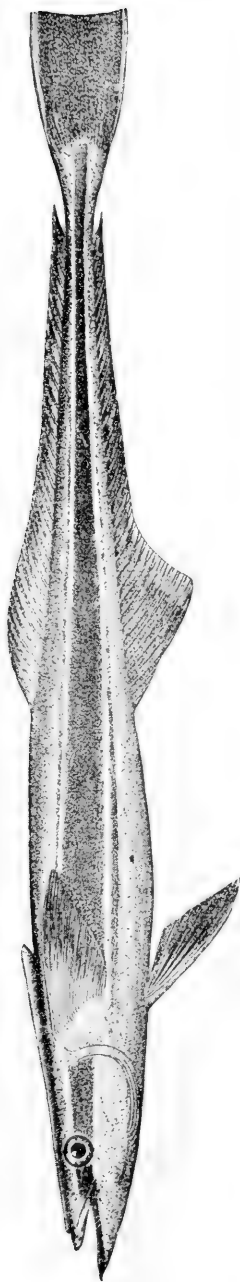






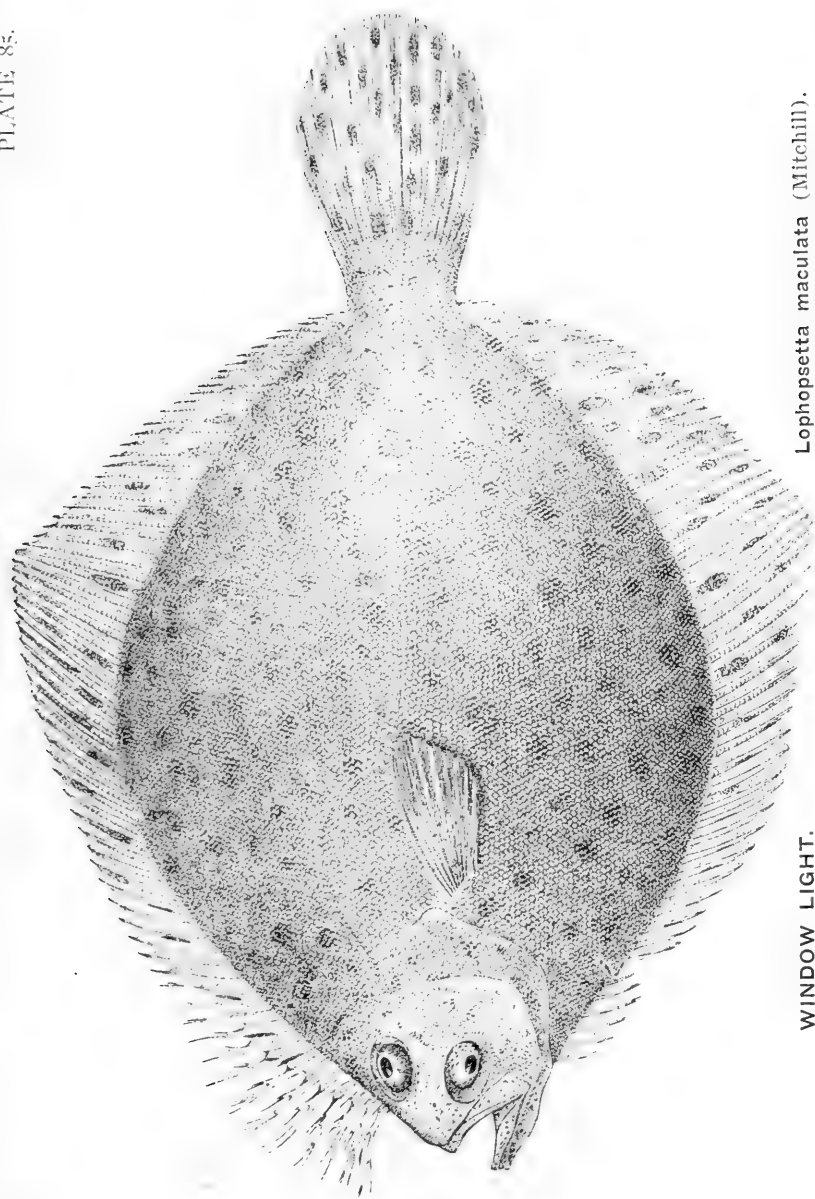
FLYING ROBIN. *Cephalacanthus volitans* (Linnæus).





SUCK FISH. *Echeneis alba-cauda* Mitchill.

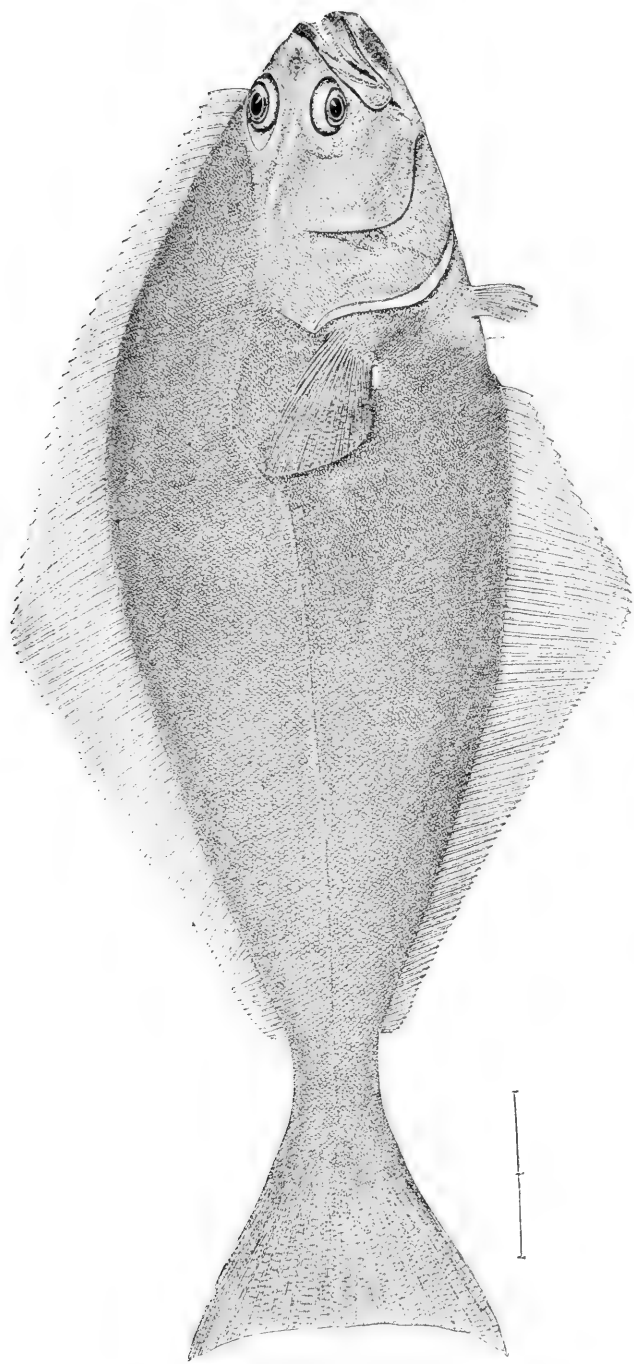




*Lophopsetta maculata* (Mitchill).

WINDOW LIGHT.

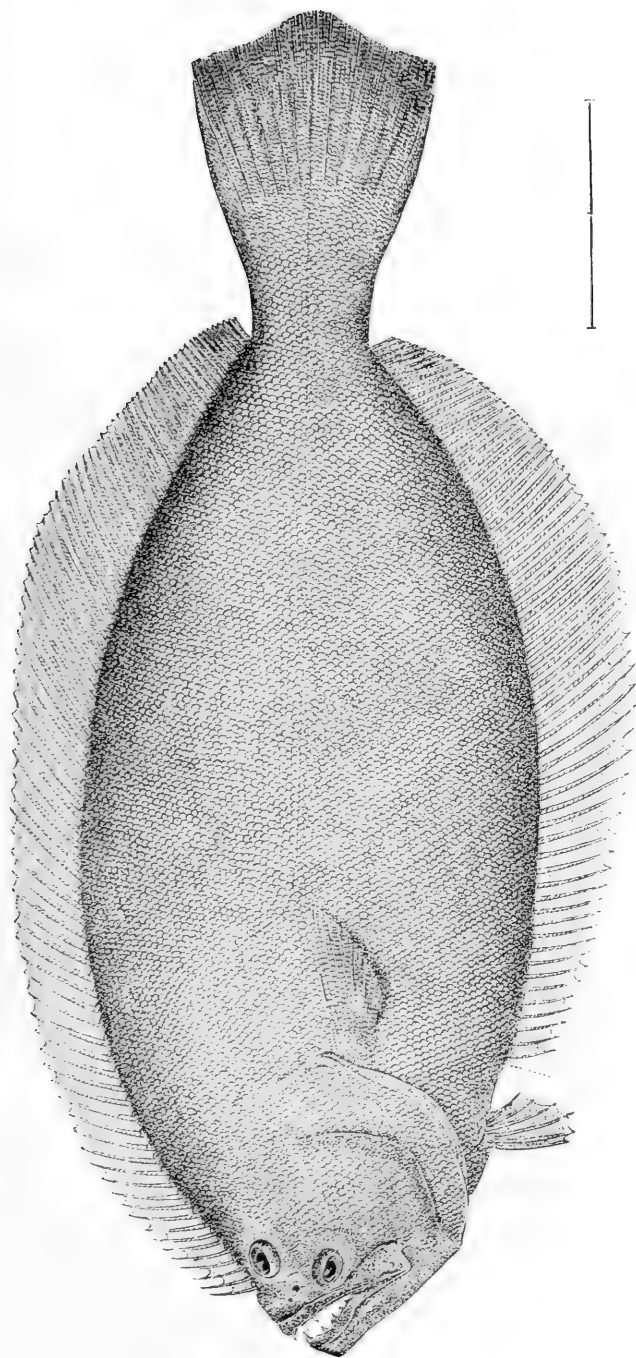




HALIBUT. *Hippoglossus hippoglossus* (Linnaeus).

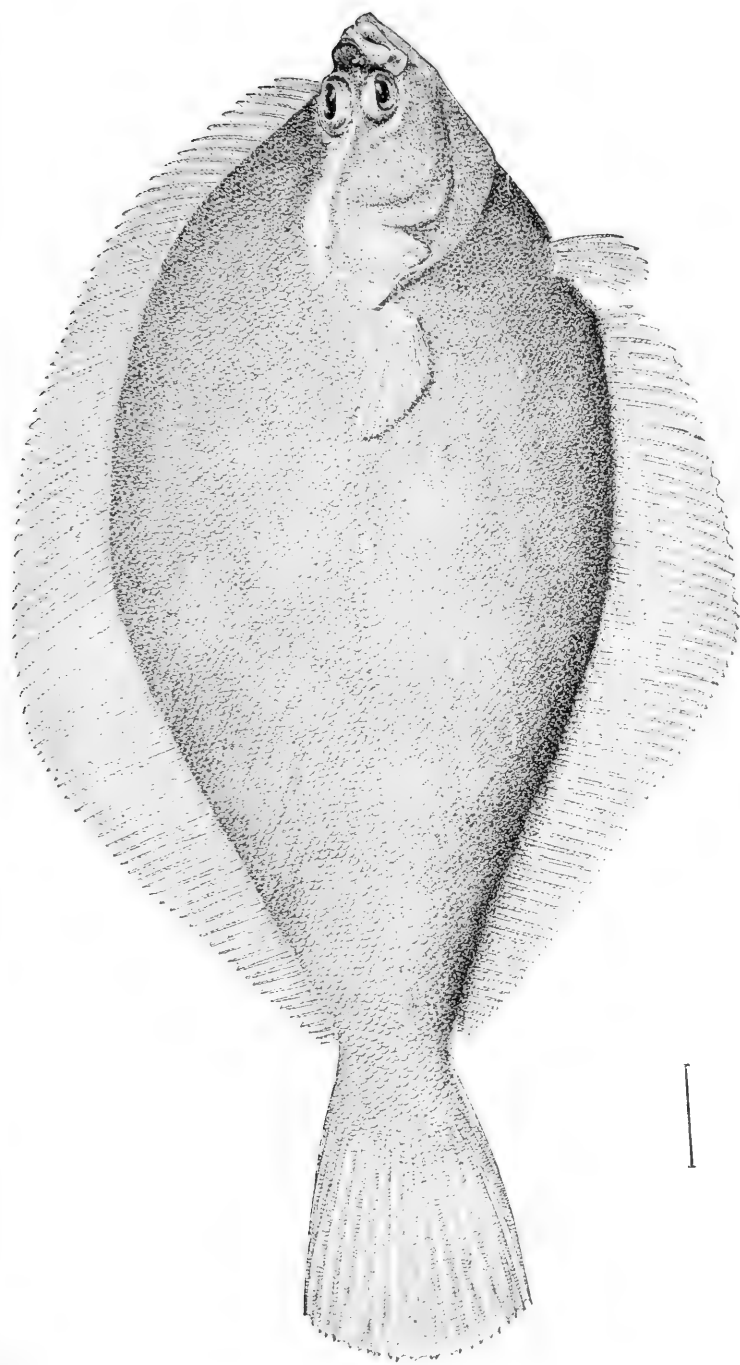






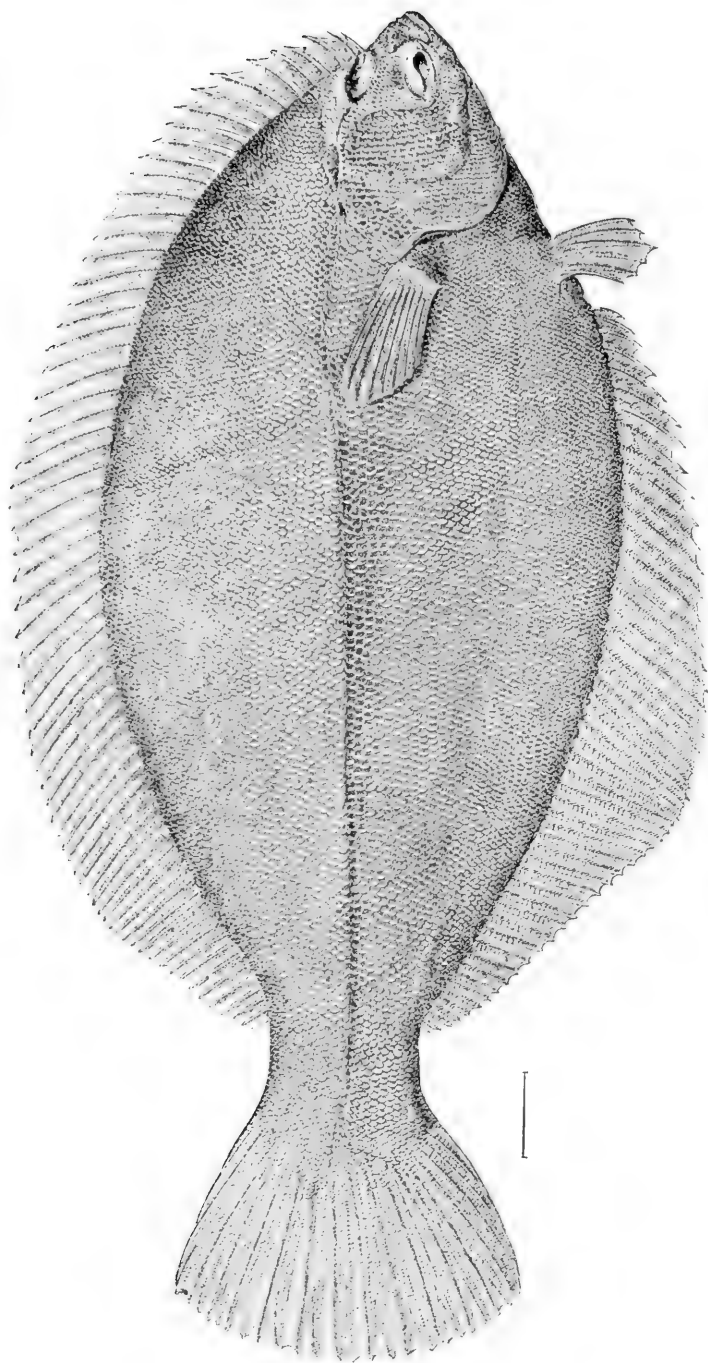
SUMMER FLOUNDER. *Paralichthys dentatus* (Linnaeus).





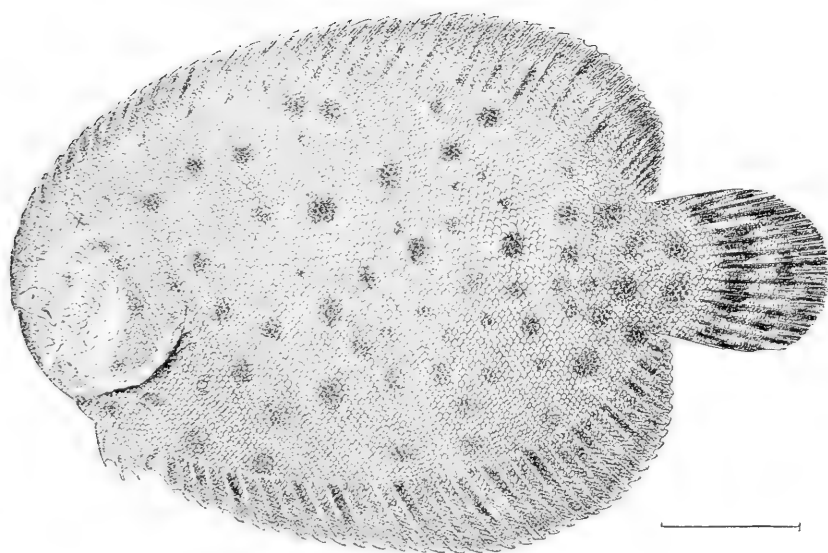
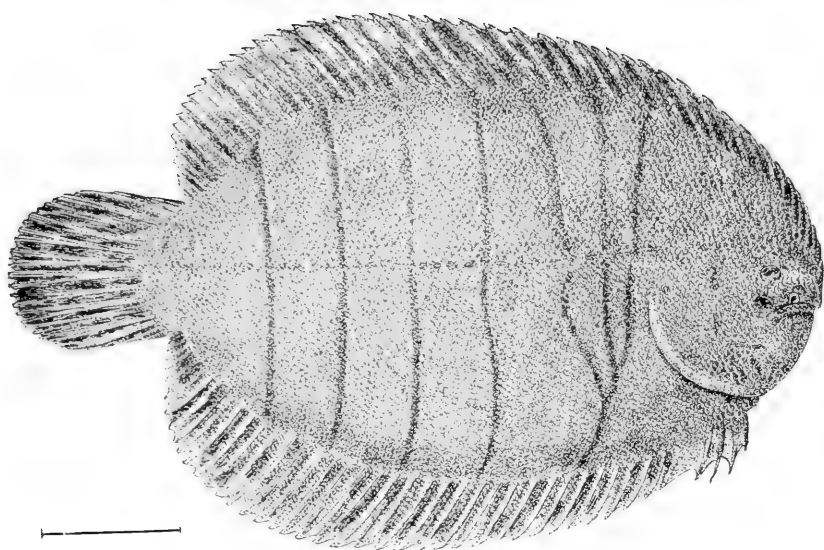
FLUKE. *Limanda ferruginea* (Storer).





WINTER FLOUNDER. *Pseudopleuronectes americanus* (Walbaum).





SOLE. *Achirus fasciatus* Lacépède.

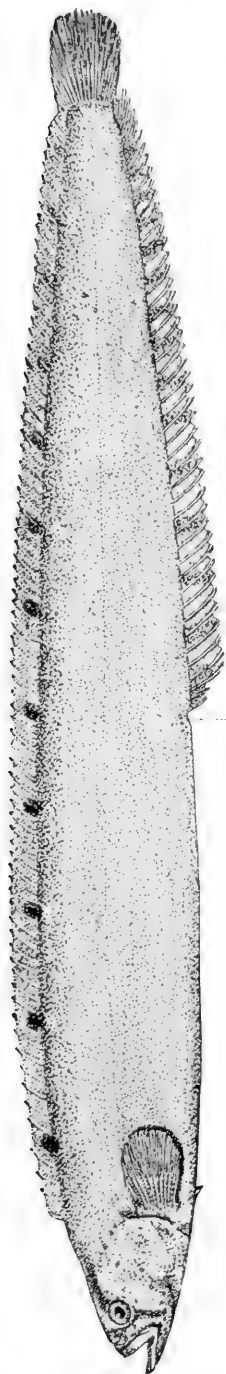






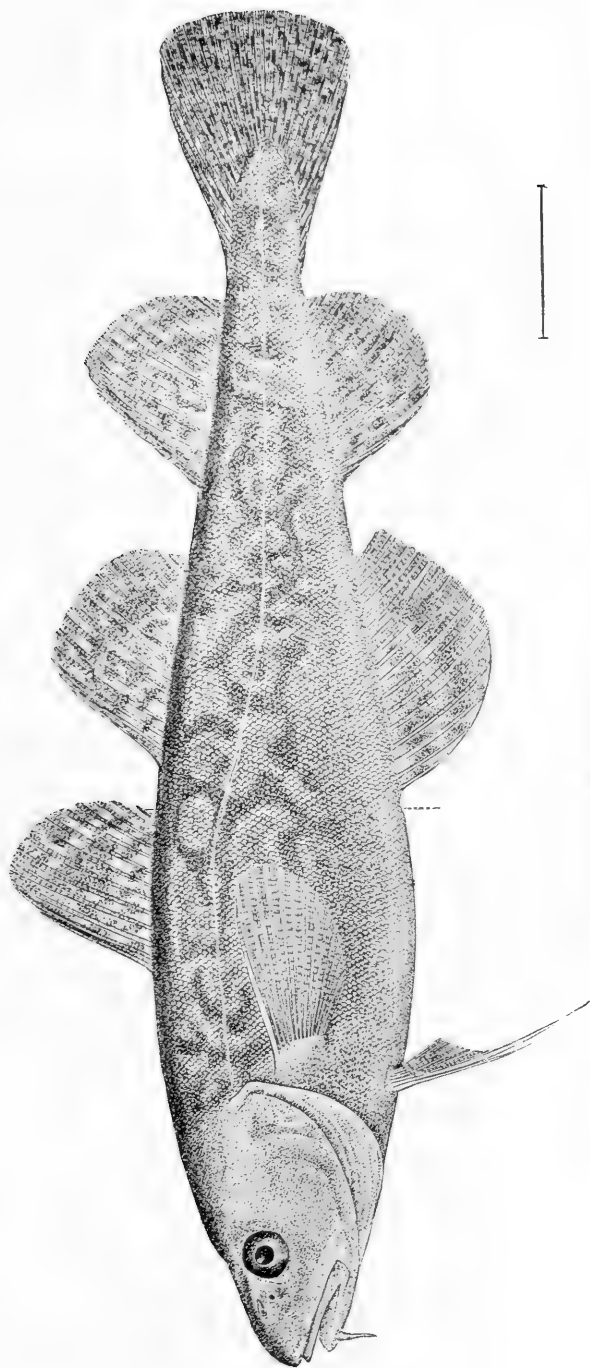
STAR GAZER. *Astroscopus y-græcum* (Cuvier).





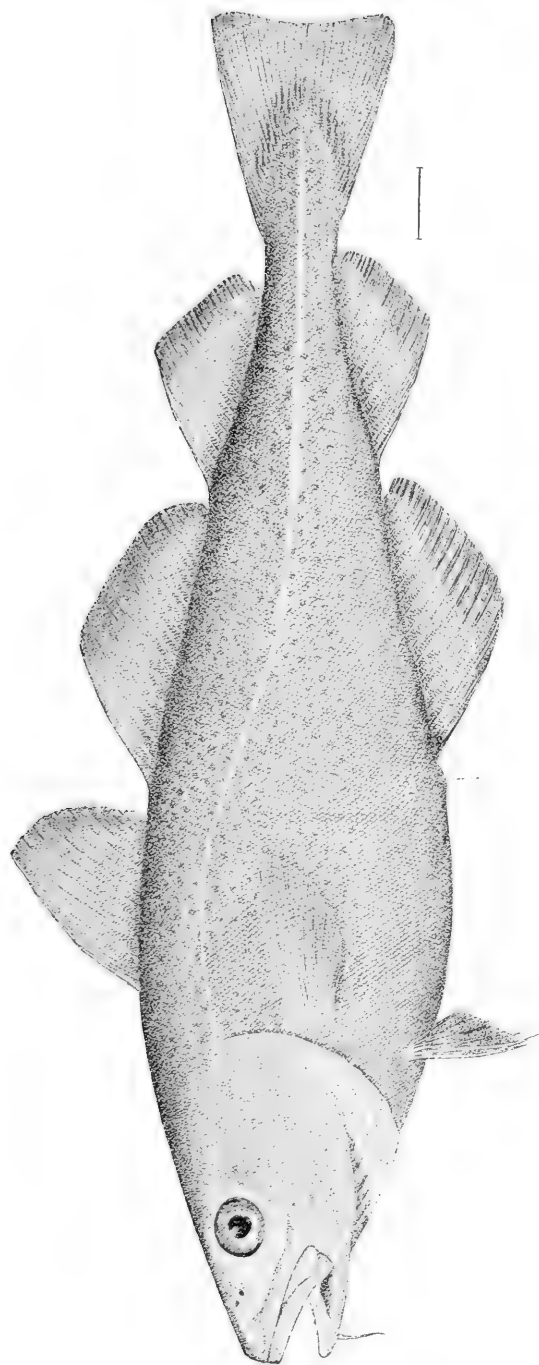
GUNNELL. *Pholis gunnellus* (Linnæus).





TOM COD. *Microgadus tomcod* (Walbaum).

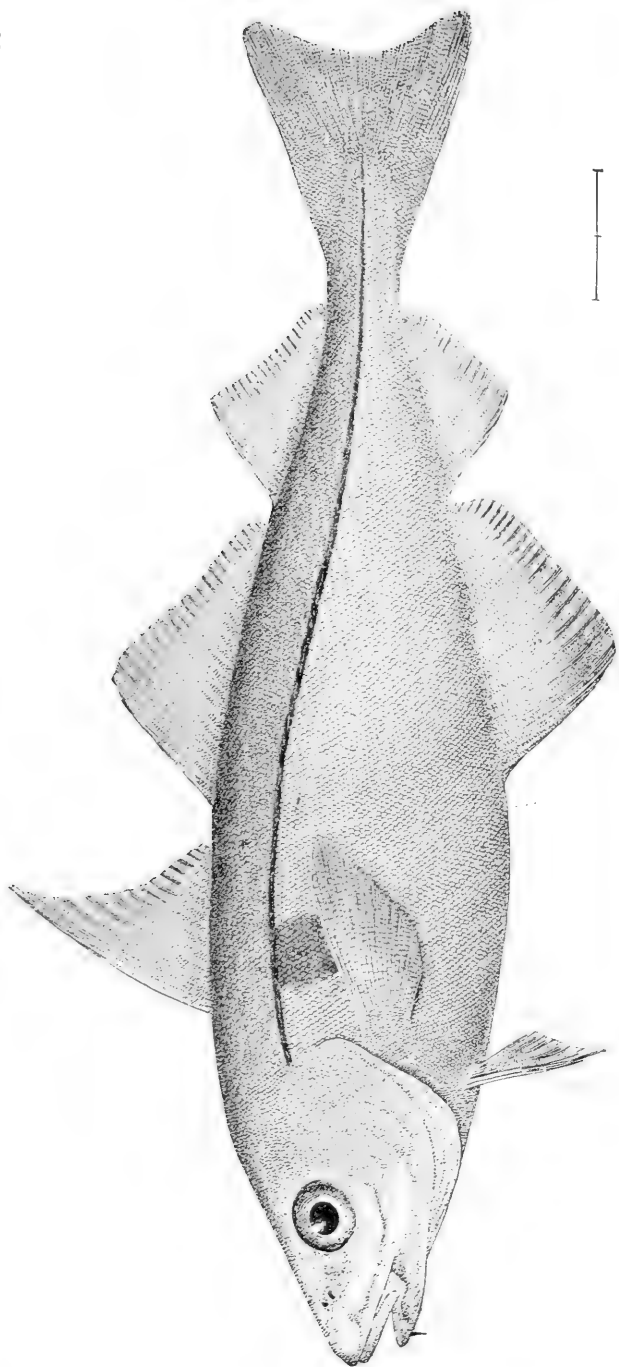




COD FISH. *Gadus callarias* Linnæus.

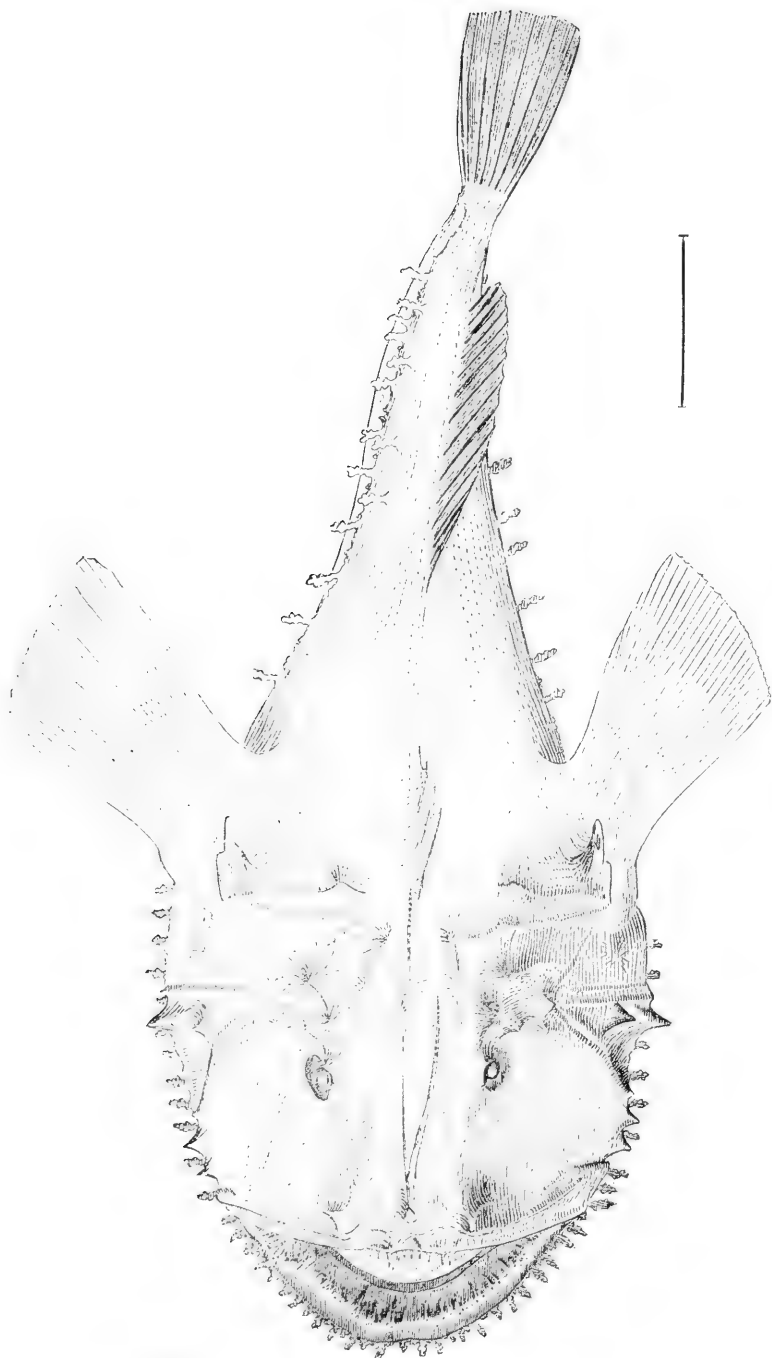






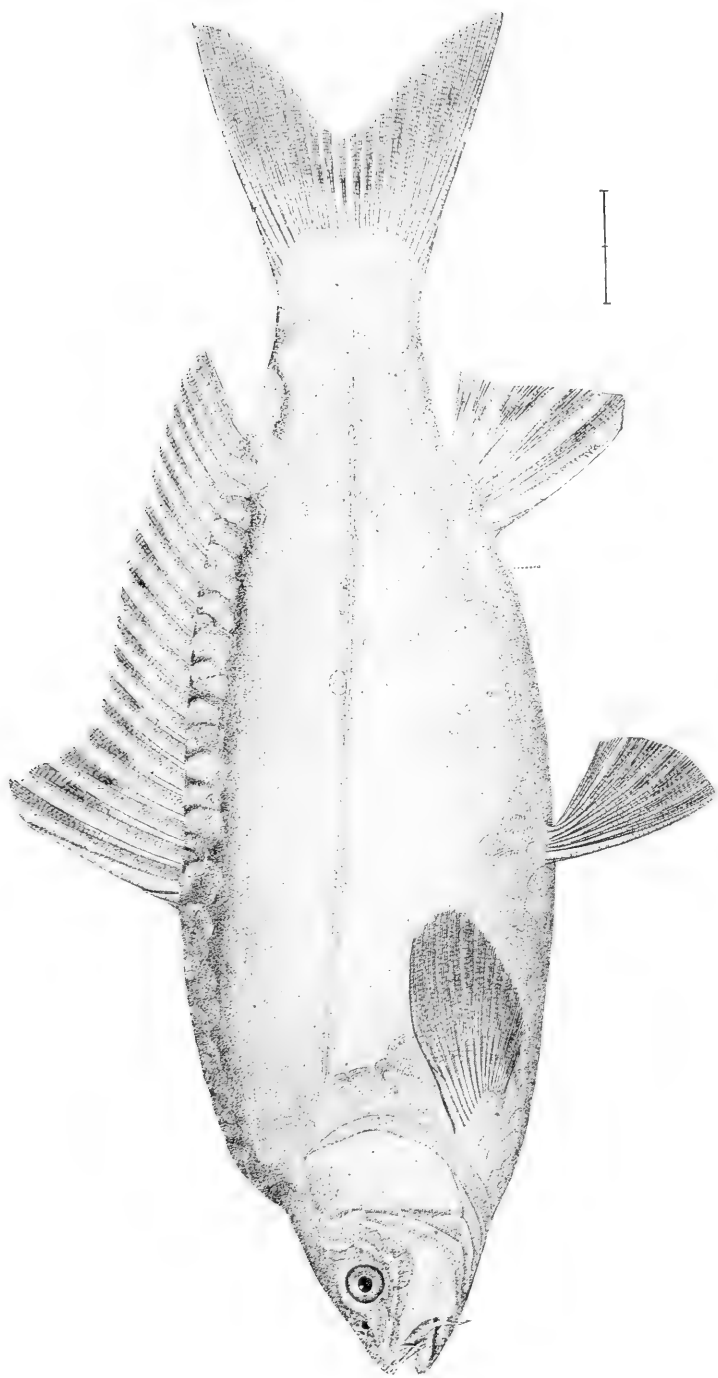
HADDOCK. *Melanogrammus æglefinus* (Linnæus).





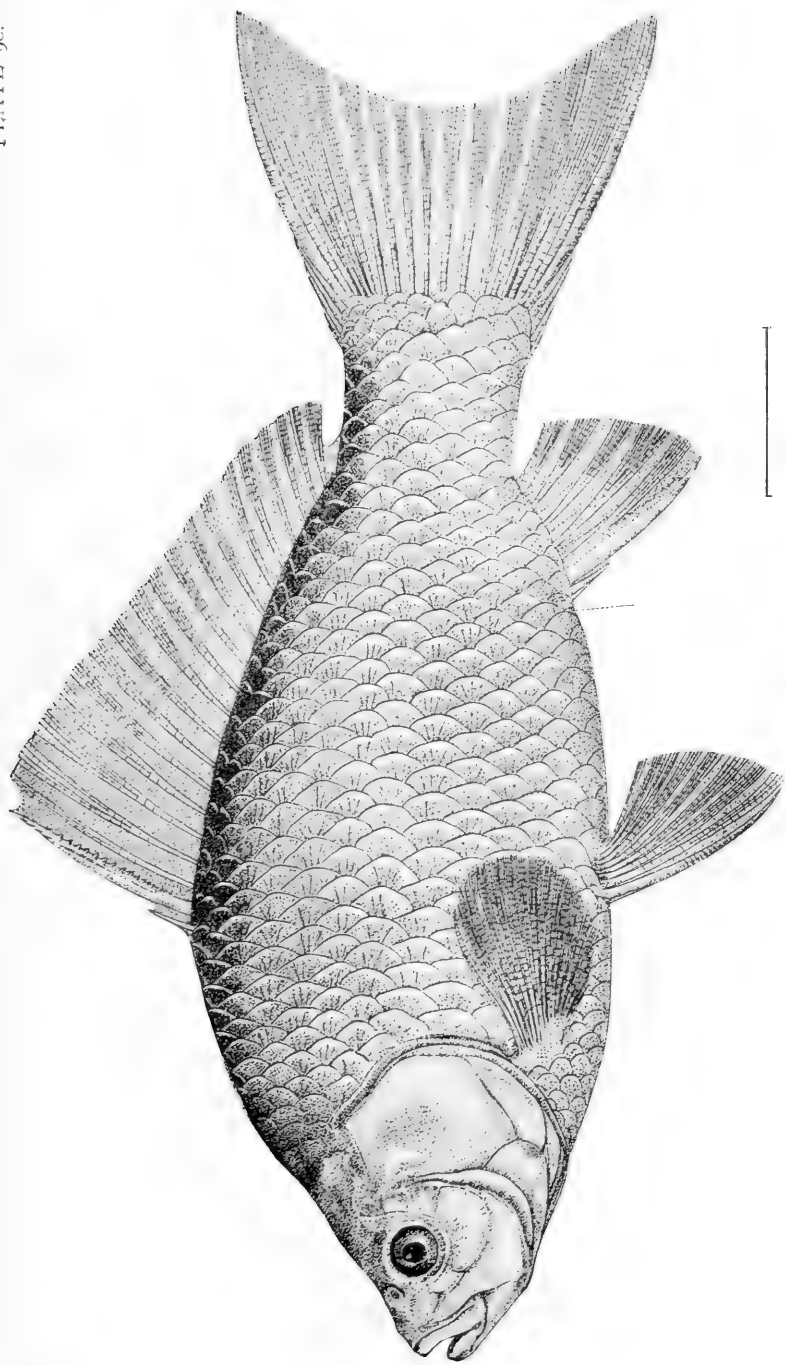
GOOSE FISH. *Lophius piscatorius* Linnæus.





LEATHER CARP. *Cyprinus carpio* Linnæus.

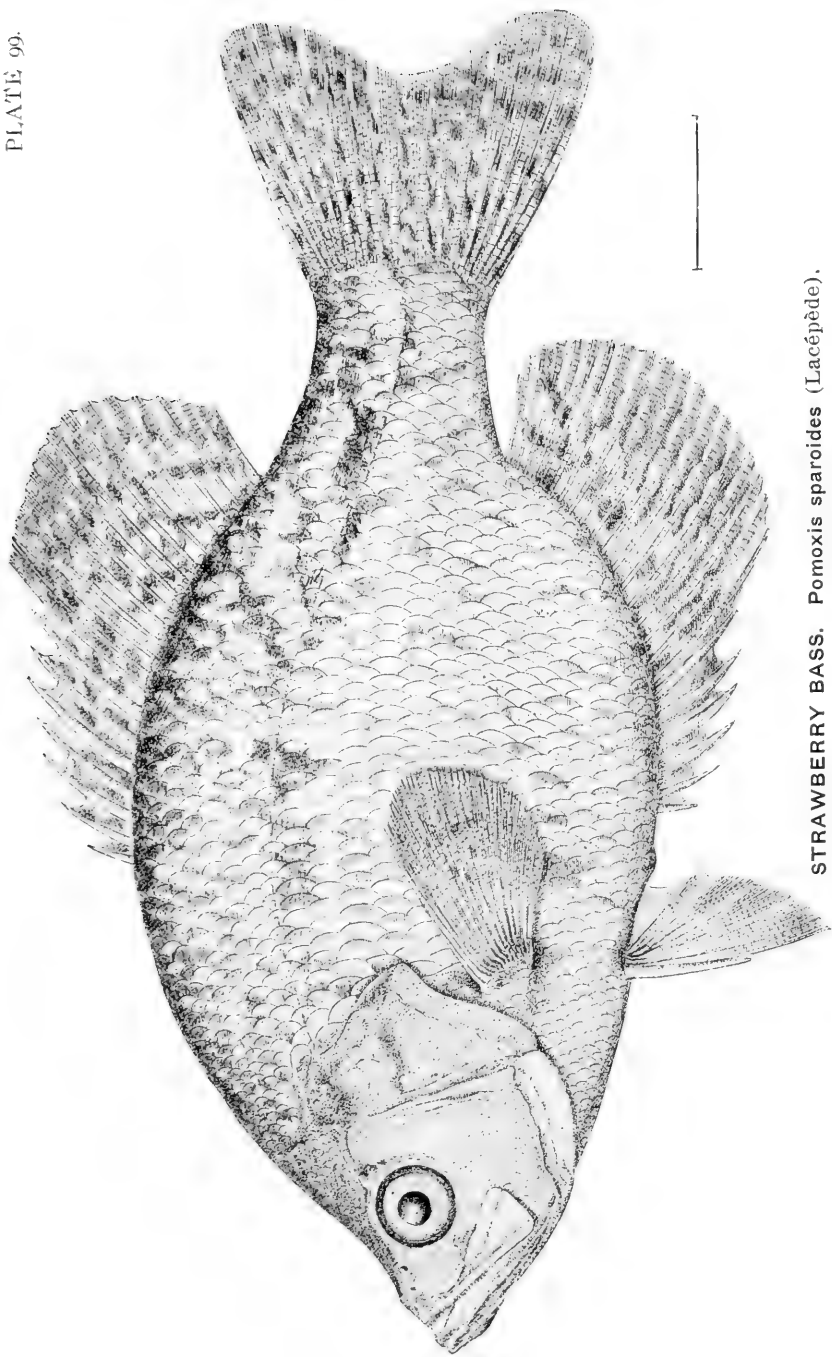




GOLD FISH. *Carassius auratus* (Linnaeus).

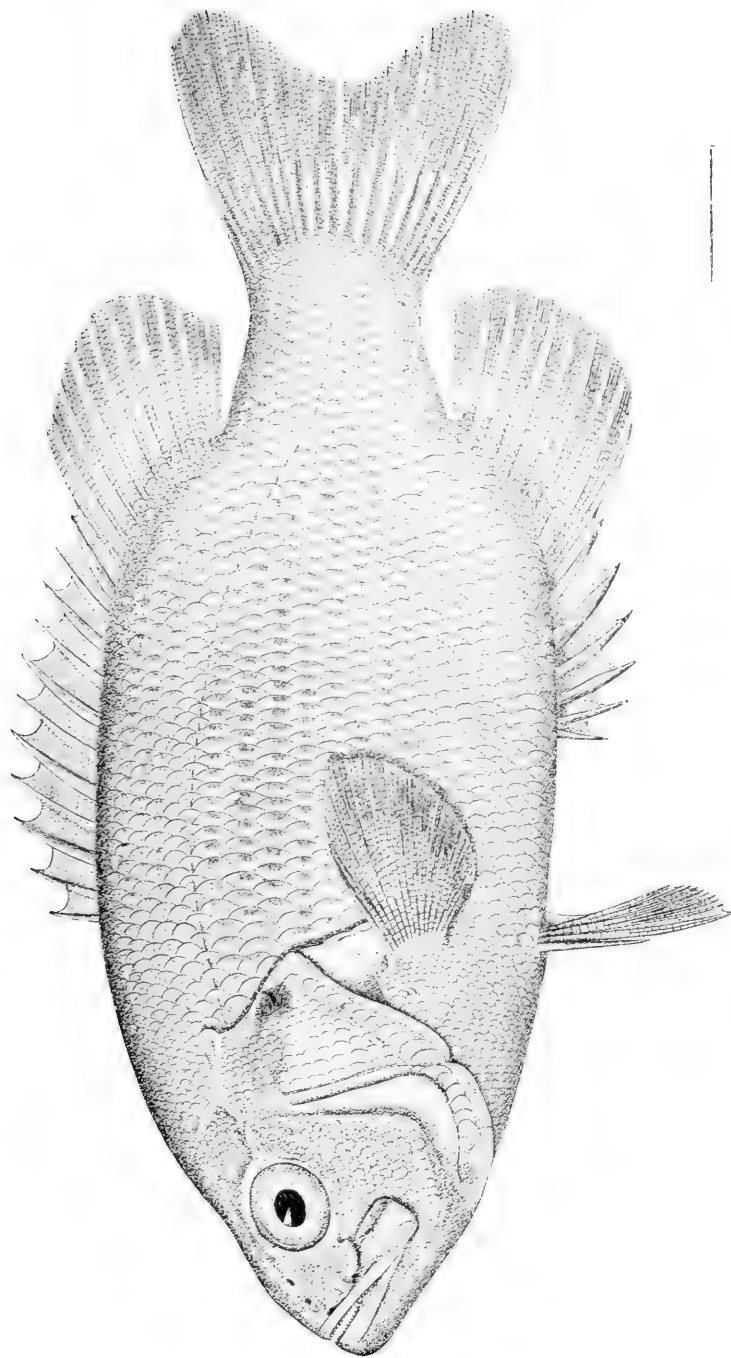






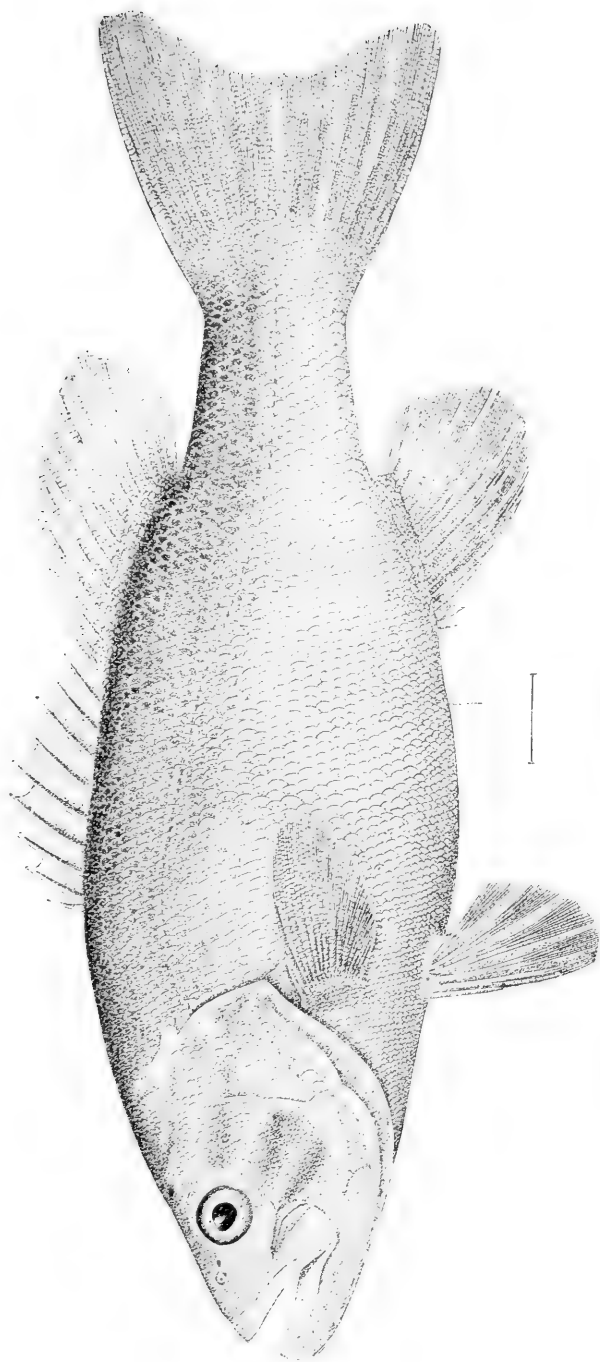
STRAWBERRY BASS. *Pomoxis sparoides* (Lacépède).





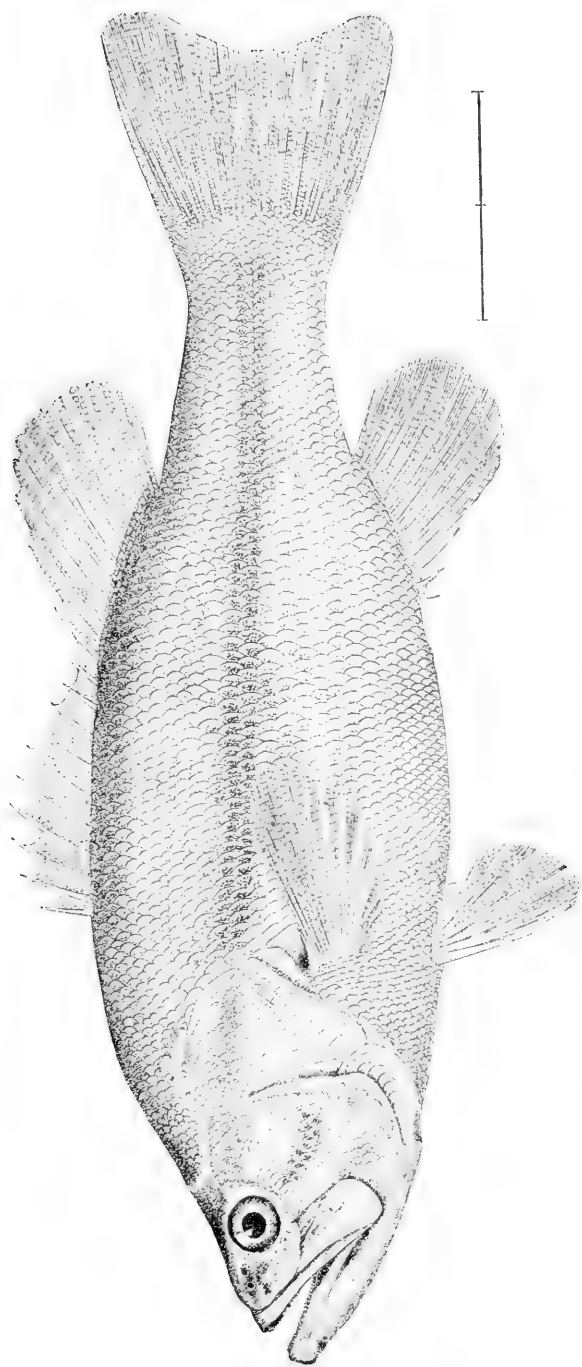
GOGGLE EYE. *Ambloplites rupestris* (Rafinesque).





SMALL MOUTHED BLACK BASS. *Micropterus dolomieu* Lacépède.





LARGE MOUTHED BLACK BASS. *Micropterus salmoides* (Lacépède).







PIKE PERCH. *Stizostedion vitreum* (Mitchill).

















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